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The Electrical Executions. THE official report by Drs. MacDonald and Ward of the electrical executions of July 7 last has at length been made public. Unfortunately it adds comparatively little to what is already known. The only thing remarkable about it is the lack of scientific results. The fact that the four men executed were immediately rendered unconscious and were dead after a brief application of the current is already known. The autopsies disclosed nothing especially new or interesting; the only thing that seems to have been proved is that alternating currents of slightly under 1,500 volts applied in a particular way, not met accidentally, require a little less than a minute in order to permanently suspend all vital functions. Judging by the results the executions were successful enough, but from an electrical point of view uninteresting.

Electricity at the World's Fair. WORK on the World's Columbian Exhibition is progressing now with satisfactory rapidity. At the banquet recently given to the foreign commissioners there were the heartiest expressions of co-operation from all of them, and the allotment of space to the various foreign powers is considerable enough to insure the presence of fine exhibits. In the electricity building 20,000 square feet each—nearly half an acre—has been given to England and Germany, while the total amount of space allotted to exhibitors abroad is 12 acres. One of the interesting features of the electrical building will be the heroic statue of Benjamin Franklin standing at the main portal. By the way, did it ever occur to you what a magnificent exhibition of daring was characteristic of Franklin's kite experiments? Knowing perfectly well the terrific force with which he was playing and the danger that he faced, the great philosopher staked his life in that effort to demonstrate the truth of his theory of the identity of lightning with electricity. Later on another investigator was killed in attempting a similar experiment. A man of such genius and courage may well be the patron saint of electricians, in so far as Benjamin Franklin could be the patron saint of anything.

Electricity in Agriculture. A NOTE elsewhere in our columns gives the results of some recent experiments on the influence of electric light and electric current on plant life. As regards the effect of light, as might have been expected, the production of artificial daylight has a strong tendency to force the growth of nearly every sort of vegetation, but something that was not so readily to be expected was a distinctly deleterious effect of too close and direct illumination. With reference to the effects of electric current, it is much more difficult to form a correct *a priori* judgment. Apparently the experiments tried were decisive in showing considerable results, but at what cost is not stated and it may well be doubted whether that method of hastening growth will ever prove to be commercial. As regards the electric light, however, the outlook is decidedly more hopeful. Already, in France, there have been extended and very successful tests on permanent hot-houses intended to produce remunerative products all the year round. In such cases, and where, too, the price to be obtained depends largely on hastening the maturity of the vegetables or fruits that are being raised, the electric light might serve a very useful purpose in turning night into day and enabling the crops to be put on the market at a considerably earlier date than would otherwise be possible.

The Discoverer of Insulation. A QUESTION has recently been raised in one of the foreign papers concerning the first use of insulated wire, and we desire here to call attention to it as a subject worthy the investigation of those of our readers who are of an historical turn of mind. It would assuredly be most interesting to know to whom first occurred the idea of covering a wire with a continuous and adherent insulating coating. We would be pleased if any of our readers who can give any information on this interesting question will communicate it to us for the benefit of the electrical fraternity at large. It should be said in making this request that the date is certainly earlier than 1825, and no references pertaining to a period later than that will have any bearing whatever on the question. Further, a mere wrapping of insulating material about that portion of an electric wire which must be handled cannot fairly be counted as insulation in the modern sense of the term; we should only consider the application of a coating of non-conducting material throughout the whole length of the wire employed in some particular piece of apparatus. Such wire certainly came into use very soon after the discovery of electro-magnetism and the consequent necessity for winding wire into compact coils. It may have antedated that period by some little time, how long we can as yet form no definite idea. We trust that some of our readers may be able to bring forward some evidence as to the real history of so important an adjunct to modern electrical practice.

Questions of Priority. A BRIEF note concerning the Stanley alternating current motor, published elsewhere in our columns, gives a striking example of a certain bent of mind that is unfortunately only too common among foreign electricians, that peculiar phase of mental development which impels the possessor to neglect and scoff at all scientific work done outside the confines of his own particular country. It is a disease not confined to any one climate or hemisphere, and is exasperating in that it denies credit to whom credit is due. It is charitable to suppose in some cases that a commercial reason lies back of the perversion of facts, rather than to imagine that the mind of a presumably intelligent man is hopelessly warped. In the case of this attack on the Stanley motor, based on a distant approximation to the same line of thought by a French writer, there may be an attempt to affect the validity of patent rights, just as in the case of the Tesla motor, which we have had occasion to discuss in these columns several times of late. A little more scientific impartiality and fairness among the electricians of various countries is devoutly to be wished; were it displayed more freely we should not be treated to the unpleasant spectacle of English writers forgetting the existence of Gauss and Morse in telegraphy, of Germans quite oblivious of the discoveries of Henry, of Frenchmen writing persistently of Mariotte's law, and, we say it in all frankness, of Americans claiming the earth in a similar fashion. The history of science ought not to be made subservient to commercial enterprise or to national pride.

Alternate Current Practice. IN the proceedings of the electrical congress recently held at Frankfort one paper stands forth pre-eminent as an exceedingly clear exposition of that branch of electro-technics that deals with alternating currents. That paper, by Von Dolivo-Dobrowolsky, we publish in full elsewhere in the current issue. We can do no better by our readers than to call special attention to it as an intensely suggestive and simple discussion of a subject necessarily somewhat abstruse. It may seem at first a somewhat daring method of investigation to drop the relations of mutual and self-induction and substitute for them the magnetization that is their common measure, yet this device makes the consideration of many problems immensely easier than the usual somewhat abstruse calculations. That this application leads to correct results needs no further proof than the beautiful results obtained by Von Dolivo-Dobrowolsky in the design of the motor for the Lauffen-Frankfort exhibition. To have built such a machine with no one of a similar model at hand larger than a two horse power, and to have put it boldly, without previous testing, on the circuit from a distant power station only to find that it ran at almost precisely the predetermined speed—all this argues not only skillful construction but the most accurate calculation. An interesting suggestion offered in the paper is the parallel between the development of alternating and direct current machinery. In the one case practice has demanded the polyphase construction for large motors, just as in the other case multipolar machines have been found necessary for heavy outputs. The efficiency of the two is not unlike, and in either case the more phases or poles the better the result given by the copper in the armature. Regarding the running of alternators in parallel, the most outspoken opinions are expressed that every alternating current machine which is correctly built for constant potential will work well in multiple arc, and better as the armature resistance is lower. The brief discussion of the latest forms of "drehstrom" motors and the principles of their construction is of great interest and directly in the line of the previous paper by the same author published in these columns a few weeks since. Altogether M. Dobrowolsky's suggestions are of the most striking character and especially interesting, and it should not be forgotten that the author is probably the most accomplished continental electrician in this particular line of work.

The Rapid Transit Problem. AFTER weary weeks of procrastination the Rapid Transit Commission appears to have found itself unable to come to any definite conclusion regarding the plans foisted upon it by its astute engineers. It will be remembered that after spending a long time in investigation, and receiving a considerable number of plans of various sorts submitted by expert engineers of widely different proclivities, these propositions were turned over to the engineers of the commission, who displayed their discriminating taste by dropping overboard the schemes entrusted to them and bringing in two propositions of their own; these were again referred to a board of consulting engineers, who have subjected them to extensive criticism. To their credit be it said that they have not followed the example of their predecessors by bringing in their individual plans but have confined themselves to the legitimate task of going over the engineering schemes that were allowed to reach them. Two distinct arrangements were proposed, one by Engineer Worthen and the other by Engineer Parsons; the former, so far as it is disclosed in the details that have been published, appears to be a rehabilitation of the old arcade road, which involves four tracks on the same level and means practically, therefore, the construction of a sub-street so far as road bed is concerned. The latter embodies a double deck road composed in the main of two separate tunnels, one on each side of the street. The opinions of the consulting engineers are at variance both with each other and with the schemes before mentioned. Mr. Octave Chanute, president of the American Society of Civil Engineers, in particular, has criticised both in considerable detail, and his opinions are worthy no small amount of respect. Mr. Chanute is very outspoken in the opinion that the best solution of the rapid transit problem will not be found by the exclusive adoption of any one general plan, owing to the widely varying character of the surroundings of the road throughout its line; he, therefore, does not indorse either of the propositions of the engineers except in a qualified way, and without proposing a definite special method has given to the commission a large number of valuable suggestions by which it will do well to profit. Altogether the rapid transit situation is decidedly muddled; the official engineers discredit all the suggestions made to them, and the agglomerated plans put forward for their own glorification have not been heartily indorsed by experts called in to pass upon them. The positive service that has been rendered is the gathering of a great deal of information regarding the difficulties that are to be met, and various ways of meeting them. Working plans, however, do not seem to be very near at hand.

Latest Foreign Electrical News.

(By cable from our Own Correspondent.)

London, Oct. 5, 1891.—Electrical matters here are looking up and the financial journals anticipate that there will be a rise in the electrical stock market.

The overhead electric system has received a blow in the action of the Edinborough town council, who have declined to sanction the erection of an experimental trolley line.

Municipal lighting plants are on the increase, and just now the Manchester city council is considering an elaborate scheme for the electric lighting of the city on the five-wire direct current system.

At the last meeting of the Cork Gas Consumers' Company the chairman announced that in deference to the wishes of many citizens the directors had finally decided to apply for electric lighting powers. The town council seemed to favor the idea, and the stockholders of the company are apparently in accord with them, so that unless the Board of Trade objects to the combination of gas and electric lighting the Cork Gas Company will shortly erect an electric light plant. To English electrical engineers the scheme will be of interest because of its novelty on this side of the Atlantic, and more especially because the company proposes to inaugurate a system of gas engine sub-stations, each supplying current to a small area.

The Work of the Brooklyn Institute.

The report of this active institution for the diffusion of knowledge for 1890-91 has just been issued in the form of a neat volume of over 200 pages, giving in detail the work of the various departments during the past year. It is a most creditable showing, and exhibits a large amount of careful work in the study of the arts and sciences. The number of members is constantly on the increase and altogether the Brooklyn Institute shows itself to be serving a most useful purpose and doing valuable work in general popular education.

Armatures with Disabled Coils.

BY J. W. DARLEY, JR.

In the article on the new Short generator in The Electrical World of Sept. 5 the statement is made that the destruction of a single coil does not affect adjacent coils, and it is even possible, in case of necessity, to run the machinery for several days without winding a burned-out coil—a feat impossible with any type of Siemens armature. My experience does not verify this assertion. I have often run Siemens armatures with not only one, but several burned out coils and obtained exceedingly satisfactory results. The method of procedure is as follows: After ascertaining which are the damaged coils the ends are to be disconnected from the communicator and thoroughly insulated from each other, and from all the other coils' terminals, virtually leaving the burnt out sections on an open circuit, the place of the discarded coils in the commutator connections being taken up by a short loop of wire, so that the circuits through the armature will be unchanged, with the exception that the currents, instead of traversing the displaced coils, pass across the loop; in some cases the short circuit occurs in such a manner that there exists an internal current in the dead coils when the armature is running, heating them up. When this effect obtains it is necessary to cut one of the coils in order to open this internal circuit; this can readily be done in most cases at the back head. A 30 kilowatt Edison armature ran successfully with as many as five burned out coils, the only evil arising therefrom being a slightly irregular action upon the commutators, and a small decrease of electromotive force.

The last occasion upon which I used this plan was with the armature of a 50 kilowatt Edison generator, used for power by the North Avenue Electric Railway Company, Baltimore, Md. Two coils of this armature were burned out by lightning several months ago; up to a few weeks past the same armature was furnishing power for three cars, and, for aught I know, is still running. I have often applied the same plan to arc motor armatures, Siemens wound, running at potentials up to 800 volts, and also to an arc elevator motor in which the potential probably reached 1,000 volts, the armature coils being also subject to the shock and jar of reversal of motion. While not absolutely correct engineering practice this method is of great assistance when a spare armature is not at hand, besides being much cheaper than rewinding each coil as it burns out.

A New Method of Galvanometer Suspension.

Mr. A. H. Allen, in the London *Electrical Review*, gives the following rather interesting suggestion:

While experimenting with a home made astatic mirror galvanometer, it occurred to me to use a fine steel wire for the connection between the needles, and suspend it from the point of a magnetized "darning needle." The result was unexpectedly successful; for after a little adjustment the arrangement was sufficiently delicate to give a deflection of three inches with 1.9 volts through 750,000 ohms, the scale being 50 inches from the mirror. The coil was composed of about 1,500 turns round the lower needle. To obtain success, the strength of the supporting magnet must be just sufficient to overcome the force of gravity on the needles; the points of contact must be smooth and fine, and the magnet must be truly vertical.

The advantages of the arrangement are: a perfectly constant zero, inappreciable friction, saving of time both in mounting and in the avoidance of broken silk suspensions, and perfect portability.

I do not suppose that this method will supplant silk and quartz fibres in laboratory instruments; but I hope it will be of use to those who, like myself, occasionally experiment with home-made apparatus.

The Stanley Alternating Current Motor.

BY WILLIAM STANLEY, JR., AND J. F. KELLEY.

La Lumière Electrique of Sept. 5 contains an article called *Réinvention Américaine*. The writer, E. R., after sneering at the ignorance of the *électriciens nouveaux-nés* of America, cites us as examples. But not satisfied with this he boldly accuses us of plagiarism in regard to the alternating current motor about which you published a note some time ago. He compares the diagram given by us in our patent specification with one in an article by M. Maurice Leblanc (*La Lumière Electrique*, tome XXXIII., p. 264). That your readers may judge for themselves we reproduce both here.

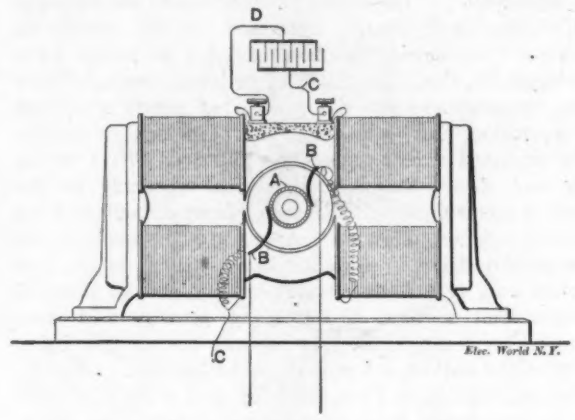


Fig. 1.—Stanley and Kelley Motor.

Now will it be believed in face of the charge of plagiarism that this diagram of M. Leblanc's represents a condenser in the armature circuit and an extra self-induction in the field? Yet such is the case. M. Leblanc's idea was to put two currents on the line, a main alternating current and an auxiliary continuous current of small magnitude. The condenser served to exclude the continuous current from the armature, the self-induction to shut out the alternating current from the field. Furthermore, in the same article, M. Leblanc expressly declares that an alternating field is too wasteful to use for large motors. In view of this declaration, even if we had derived our knowledge of the property of the condenser as a neutralizer of self-induction from M. Leblanc, which we did not—the knowledge has been public property since Maxwell—we think that, having succeeded in making the motor efficient, to us belongs the

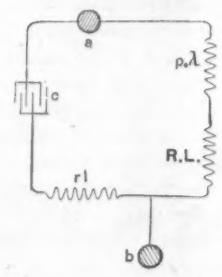


Fig. 2.—Leblanc Motor System.

credit of the invention. That M. Leblanc has since altered his views, and now believes in a motor in which the field alternates or rotates does not lessen our rights—it merely raises him to the level of a co-inventor.

On the whole, the *réinvention Américaine* appears to be French—to be the invention of M. E. R. As to M. Leblanc, we seize this opportunity of again expressing our appreciation of the merits of his work.

(*Copyrighted, 1890.*)

Chronological History of Electricity, Galvanism, Magnetism and the Telegraph, from B. C. 2637 to A. D. 1888.—Part I.*

BY P. F. MOTTELAY.

A. D. 1777.——Pringle (Sir John), a man of great scientific attainments, who was physician to the Duke of Cumberland as well as to the Queen's household, became a baronet in 1766, and afterward received many distinguished honors from foreign learned bodies, resigns the Presidency of the English Royal Society, which he had held since the year 1772. In this, as will be seen at a later date, he was succeeded by Sir Joseph Banks, who continued in the office a period of 42 years. The cause which led to his resignation is best given in the following extract from his biography in the English Cyclopedia:

"During the year 1777 a dispute arose among the members of the Royal Society relative to the form which should be given to electrical conductors so as to render them most efficacious in protecting buildings from the destructive effects of lightning. Franklin had previously recommended the use of points, and the propriety of this recommendation had been acknowledged and sanctioned by the Society at large. But, after the breaking out of the American Revolution, Franklin was no longer regarded by many of the members in any other light than an enemy of England, and as such it appears to have been repugnant to their feelings to act otherwise than in disparagement of his scientific discoveries. Among this number was their patron George III., who, according to a story current at the time, and of the substantial truth of which there is no doubt, on its being proposed to substitute knobs instead of points, requested that Sir John Pringle would likewise advocate their introduction. The latter hinted that the laws and operations of nature could not be reversed at royal pleasure; whereupon it was intimated to him that a President of the Royal Society entertaining such an opinion ought to resign, and he resigned accordingly."

In Benjamin Franklin's letter to Dr. Ingen-housz, dated Passy, Oct. 14, 1777, occurs the following: "The King's changing his *pointed* conductors for *blunt* ones is therefore a matter of small importance to me. If I had a wish about it, it would be that he had rejected them altogether as ineffectual." It was shortly after the occurrence above alluded to that the following epigram was written by a friend of Dr. Franklin:

"While you, Great George, for knowledge hunt,
And sharp conductors change for blunt,
The nation's out of joint:
Franklin a wiser course pursues,
And all your thunder useless views,
By keeping to the *point*."

Thomson informs us ("Hist. Roy. Soc." pp. 446-447) that the Board of Ordnance having consulted the Royal Society about the best mode of securing the powder magazine, at Purfleet, from the effects of lightning, the Society appointed Mr. Cavendish, Dr. Watson, Dr. Franklin, Mr. Robertson and Mr. Wilson a committee to examine the building and report upon it. These gentlemen went accordingly, and the first four recommended the erecting of pointed conductors in particular parts of the building, as a means which they thought would afford complete security. Mr. Wilson dissented from the other gentlemen, being of opinion that the conductors ought not to be pointed but blunt, because pointed conductors solicit and draw down the lightning which might otherwise pass by. He published a long paper on the subject, assigning a great variety of reasons for his preference (*Philosophical Transactions*, Vol. LXIII., p. 49). It was this dissent of Mr. Wilson which produced the controversy between the electricians of the Royal Society respecting the comparative merits of pointed and blunt conductors, a controversy which continued for a number of years, and a variety of papers in support of both sides of the question made their successive appearance in the *Philosophical Transactions*. Indeed, it occupies almost the exclusive attention of the writers on electricity for several successive volumes of that work.

See William Henley, "Experiments . . . . pointed and blunted rods . . . " in *Phil. Trans.* for 1774, p. 133; P. D. Viegeron, "Mémoire sur la force des pointes . . . "; Edward Nairne, "Experiments . . . advantage of elevated pointed conductors," in *Phil. Trans.* for 1778, page 823; Lord Mahon, "Principles . . . . superior advantages of high and pointed conductors," London, 1779; Hale's "Franklin in France," 1880, Part I., p. 91, and Part II., pp. 254-256, 279, for some of his other correspondence with Dr. Ingenhousz; likewise Part II., pp. ix, 273, 441-451, regarding the first publication of copies of letters written by Franklin to Sir Joseph Banks, which, "for some curious reason," Mr. Hale remarks, were not publicly read and were never included in the *Philosophical Transactions*, as Franklin intended they should be. See, also, Thomas Hopkinson, "on the effects of points, etc.," in Franklin's "New Experiments, etc.," London, 1754; Tilloch's *Philosophical Magazine* for 1820; Jared Sparks' edition of Franklin's Works, and Sir John Pringle's discourse delivered at the Anniversary Meeting of the Royal Society, Nov. 30, 1774, a translation of the last named appearing at page 15, vol. XV., of the "Scelta d'Opuscoli."

A. D. 1778.——Martin (Benjamin), English artist and mathematician, who had already written an "Essay on Electricity" and a supplement thereto (1746–1748), publishes an enlarged edition in three volumes of his "Philosophia Britannica," originally produced in 1759. At volume I., p. 47, of the last named work, he states that his experiments indicate a magnetic force inversely as the square roots of the cubes of the distances. Noad, treating of the laws of magnetic force, says ("Electricity," p. 579) that Martin and Tobias Mayer both came to the conclusion that the true law of the magnetic force is identical with that of gravitation, and that, in the previous experiments of Hauksbee and others, proper allowance had not been made for the disturbing changes in the magnetic forces so inseparable from the nature of the experiments.

His lecture I. explains all the phenomena of electricity and magnetism, the appendix thereto detailing numerous experiments of Mr. John Canton, and giving many additional facts concerning the manufacture of artificial magnets. From his preface the following extracts will, doubtless, prove interesting: "We are arrived at great dexterity since Sir Isaac Newton's time; for we can now almost prove the existence of this *æther* by the phenomena of electricity; and then we find it very easy to prove that

electricity is nothing but this very *æther* condensed and made to shine. But I believe, when we inquire into the nature and properties of this æther and electricity, we shall find them so very different and dissimilar, that we cannot easily conceive how they should thus mutually prove each other. . . . I see no cause to believe that the matter of electricity is anything like the idea we ought to have of the *spiritus subtilissimus* of Sir Isaac. . . . The smell also of *electrical fire* is so very much like that of *phosphorus*, that we may be easily induced to believe a great part of the composition of both is the same."

See "Encycl. Britan," 1857, vol. XIV., page 320; Antoine Rivoire (Rivière), "Traités sur les aimants . . .," Paris 1752; Nicolaus von Fuss, "Observations . . . aimants . . .," Petersburg, 1778; Le Noble, "Aimants artificiels . . .," Paris, 1772, and "Rapport . . . aimants," 1783 (Mém. de Paris); Wens, "Act. Hill," vol. II., page 264; C. G. Sjoestén (Gilbert, *Annalen der Physik*, vol. XVII., p. 325; Rozier, IX., 454.

A. D. 1778.——Toaldo (Giuseppe) Abbé, celebrated Italian physicist, who had in 1762 been made professor at the Padua University and was the first one to introduce the lightning rod in the Venetian States, makes known the merits of the last named invention through his "Dei conduttori per preservare gli edifizj, etc.," which latter work embraces most of his previous treatises on metallic conductors as well as the translation of H. B. de Saussure's "Exposition abrégée, etc," Geneva, 1771, and of M. Barbier de Tinan's "Considérations sur les conducteurs en général."

The above was followed by many highly interesting memoirs containing valuable meteorological observations, notably those in continuation of the work of J. Poleni, made close up to the time of his sudden death at Padua, Dec. 11, 1798. His complete works, covering the period 1773–1798, were published in Venice through M. Tiato, with the assistance of Vincenzo Chiminello, during the year 1802.

See, in addition to the last named publication (entitled "Completa Raccolta di Opuscoli, etc."), "Mem. della Soc. Ital.," vol. VIII., Pt. 1, p. 29 ("Elogio . . . da A. Fabbroni," 1799); Larousse, "Dict. Universel," vol. XV., p. 251; "Biographie Générale," vol. XLV., p. 450; "Biografia degli Italiani Illustri, etc.," by E. A. Tipaldo, vol. VIII.; "Padua Acad. Saggi," vol. III., p. CV.; "Opus Scelti," vol. VI., p. 265, vol. VII., p. 35; "Nuovo Giornale Enciclopedico di Vicenza" for 1784; Antonio Maria Lorgna, 'Lettera . . . parafulmini," 1778; G. Marzari (vol. II., p. 73, of "Treviso Athenæum"); Fonda "Sopra la maniera . . ." Roma, 1770; G. Marzari e G. Toaldo "Memoria Descrizione . . . 25 Aprile, 1786; Barbier de Tinan, "Mémoire sur la manière, etc.," Strasbourg, 1780; F. Maggiotto's letter to Toaldo upon a new electrical machine; Sestier et Méhu, "De la foudre, etc.," Paris, 1866.

Vincenzo Chiminello, nephew of Giuseppe Toaldo, whom he succeeded at the Padua Observatory and who continued the *Giornale Astrometeoroligico* after his uncle's death, is the author of works on the magnetic needle, on lightning conductors, etc., which are treated of in the columns of the *Mem. Soc. Ital.*, vols. VII. and IX., the *Giornale Astromet.* for 1801, 1804, 1806, as well as in the *Saggi . . . dell' Accad. di Padova, Nuova Scelta d'Opuscoli*, and *Opuscoli Scelti sulle scienze e sulle arti.*

See Chiminello's biography, *Giorn. dell' Ital. Lettera*, etc., Serie. II., tom. XVII., p. 164, and in "Atti della Soc. Ital.," Modena, 1819.

A. D. 1778.——Dupuis (Charles François), eminent French writer who, at the age of twenty-four, became professor of rhetoric at the College of Lisieux, constructs a telegraph upon the plan suggested by Amontons (A. D. 1704). By means of this apparatus he exchanged correspondence with his friend Mr. Fortin, then residing at Bagneux, until the commencement of the Revolution, when he deemed it prudent to lay it permanently aside. (See *Encyclopædia Britannica*, 1855, vol. VIII., p. 263.)

A. D. 1778.——Brugmans—Brugman (Anton), who was professor of philosophy at the University of Francker, between 1755 and 1766, publishes his "Magnetismus, seu de affinitatibus magneticis," and is besides the author of several works upon magnetic matter and the magnetic influence, which appeared 1765–1784 and are alluded to by Poggendorff ("Biog.-Liter. Hand.," vol. I., page 316), as well as in the "Vaderlandsche Letter" for 1775 and 1776 and at page 34, vol. I., of Van Swinden's "Recueil de Memoires . . ." La Haye, 1784.

It was in this same year, 1778, that Sebald Justin Brugmans—Brugman—son of Anthon Brugmans, a distinguished physician, naturalist and author and the successor of Van Swinden at the Francker University, discovers that cobalt is attracted while bismuth and antimony are repelled by the single pole of a magnet, thus laying *the foundation of the science of dia-magnetism.*

De Humboldt remarks: "Brugmans, and, after him, Coulomb, who was endowed with higher mathematical powers, entered profoundly into the nature of terrestrial magnetism. Their ingenious physical experiments embraced the magnetic attraction of all matter, the local distribution of the force in a magnetic rod of a given form, and the law of its action at a distance. In order to obtain accurate results, the vibrations of a horizontal needle suspended by a thread, as well as deflections by a torsion balance, were in turn employed."

See "Biographie Générale," vol. VII., page 582; Larousse, "Dict. Univ.," vol. II., page 1,334; "Catalogue Sc. Papers Roy. Soc.," vol. I., page 672; W. H. Wollaston, "Magnetism of . . . Cobalt and Nickel" (*Edinb. Phil. Jour.*, vol. X., page 183); Kohl on pure cobalt (L. F. F. Crell's "Neuste Ent.," vol. VII., page 39); Tyndall, "Researches on Dia-Magnetism," London, 1870, pages 1, 90, etc.; Appleton's Encyclopædia, 1870, vol. IV., page 10; Humboldt's "Cosmos," 1859, vol. V., page 61; Augustin Roux, "Expériences nouvelles . . ." (*Journal de Médecine*, for November, 1773).

A View in Machinery Hall, Frankfort.

We reproduce here an interesting reminder of the Frankfort exhibition, a photograph of a portion of the interior of the machinery hall showing the elaborate way in which our German friends went in for striking effects. The portion of the hall that is shown is that largely devoted to the exhibit of the great Helios Company, which, with Siemens & Halske, Schuckert, and the Oerlikon Works, were the principal exhibitors. In the foreground is one of the large alternators of the Helios Company directly connected to a compound engine. This apparatus is of 600 h. p. and is intended for incandescent lighting in large central stations. This type of compound machine is decidedly unfamiliar to American eyes, although it involves no specially novel principles. The lighting effects in this part of the exhibition were particularly good, and the artistic skill of the German electrolier designers is shown by the two highly ornamental columns that rise in the foreground of the picture. The Helios Company is one of the best known on the continent, and central stations on its system are widely scattered through Europe and other parts of the world.

VIEW IN MACHINERY HALL, FRANKFORT ELECTRICAL EXPOSITION.

The Electric Light in Agriculture.

A report on the effects of the electric light on plants comes from the Agricultural Experiment Station of Cornell University, where studies have been made of the influence of the electric arc lamp upon greenhouse plants. Radishes were strongly attracted by the light, and all leaned at an angle of from 60 degrees to 45 degrees toward the lamp. Other phenomena of similar nature were noted. The report says: "There are a few points which are clear—the electric light promotes assimilation, it often hastens growth and maturity, it is capable of producing natural flavors and colors in fruits, it often intensifies colors of flowers, and sometimes increases the production of flowers." It is added that the experiments show that plants do not need periods of darkness for rest. "There is every reason, therefore, to suppose that the electric light can be profitably

used in the growing of plants," and the further inference is "that, if the electric light makes plants to assimilate during the night and does not interfere with growth, it must produce plants of great size and marked precocity." Experiments have been carried out in France, in Lot-et-Garonne, by M. Barat, upon the application of the electric current to the culture of potatoes, tomatoes and hemp. A row of hemp, subjected to the influence of the electric current, produced a row of stalks 18 inches higher than those not electrified in the same time. A kilogram (2.2 lbs.) of potatoes planted in the path of the current produced 21 kilograms of very large and healthy tubers, while the unelectrified patches only gave 12½ kilograms of medium size. The electrified tomatoes also became ripe some eight days before the others. A curious fact has been remarked by M. Barat in his experiments. If a quantity of manure is near the positive pole; the constituent parts of this manure are transported toward the negative pole, and their effects make themselves felt around a distance of some yards. This would seem to be a fresh proof of the opinion long advanced upon the part played by electricity in the growth of plants, an opinion also adopted by Mr. Specnew, who has given some attention to these phenomena; this is, that the action of the electric current upon plants seems to consist in the more active dissolution of the organic principles existing in the soil which are thus brought within the reach of the roots.

Electrical Transmission of Power by Alternating Currents.*

BY M. VON DOLIVO-DOBROWOLSKY.

The problem of transmitting power by means of alternating currents has recently occupied electricians to a great extent. Many efforts have been made in that line and a great many pens have been worn out. The problem was discussed, experiments were shown, formulæ deduced and constructions drawn which looked like spiders' webs, in the ardor to demonstrate the practicability or impracticability of alternating currents for motor purposes. Once it was said the circo-magnetization of the iron caused too great losses, or it was pointed out that the self-induction and the displacement of the phases led to apparatus of gigantic dimensions, or it was figured out by the celebrated method of considering always the maximal efficiency that the theoretical economy would be only 50 per cent.

Gentlemen: This is an exact repetition of what we have experienced in the development of the continuous current machine. The pure mathematical analysis of the alternating current had led to a perfect knowledge of the underlying natural laws, but it did not furnish material or principles for constructions to the practical electrical engineer, and did not allow a plain graphical description of such cases as occurred in practice. These were the reasons why the art was so far behind with the alternating current, many unsatisfactory constructions were made and a good deal of superstition and mysticism circulated about the alternating current. If some apparatus did not work properly then self-induction or want of it was blamed for it.

The real progress in the art of using alternating currents began since the so-called English school of electrical engineers expressed some "unorthodox" but clear symbolic opinions and ideas about that subject.

Just there, where the scientific theory becomes so complicated as here, it is absolutely necessary to separate theory and technology. For each of the two a special bent

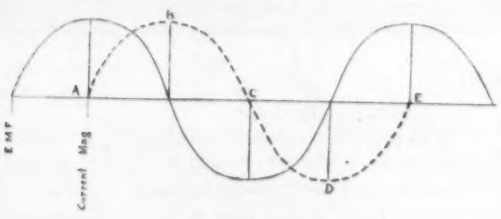


FIG. 1.

of the mind is required, a different construction of the brains—if you permit me to use that expression—is necessary. There are and must exist, of course, some ties, some connections between the two fields, so that practice does not lose its basis and theory does not forget its purpose; on a whole, however, a separation *de corps* is an imperative necessity.

Based upon the opinions of some electrical engineers on alternating currents, I should like to bring before you in the following outlines of the practice of this kind of currents, with some symbolic pictures and laws of the transmission of power by alternating currents. I shall try to characterize, so to speak, the difference of the two modes of reasoning. If I should become occasionally a little polemic, or leap suddenly from one subject to another, I beg you to consider that I give here only symbolic illustrations in order to indicate what I want to call the theory of alternating currents.

If varying magnetism pulsates around a conductor, for instance, around a spool, then the indicated E. M. F. of that spool will have—expressed in volts—a mean value, the E. M. F. $= 2\,p\,w\,N\,10^{-8}$.

w = number of windings on the coil.
p = number of periods per second.
N = number of enclosed lines of force.

Supposed that we have a fixed number of alternations, because it was furnished to us, and that the number of windings on the coil is invariable because the spool was wound for that number and is finished, then we find that the E. M. F. is simply a function of the lines of force—E. M. F. $= c\,N$. In other words, E. M. F. is a measure for N and vice versa, that is if the number of alternations is fixed, then the magnetism and E. M. F. of the apparatus are equal with the exception of a constant coefficient. The E. M. F. of the coil is hereby absolutely the same, no matter whether the magnetism is generated by the current flowing in the coil or whether it is generated partly or wholly by outside sources. There is in general no difference yet of induction and self-induction, and therefore there is no need of special measures for the same as long as we have so convenient a measure for the magnetism in the number of the lines of force. It is quite immaterial for the coil whether the E. M. F. is produced by changing reversals of the magnetism or whether it is connected with an already existing E. M. F. Outside of the correction to

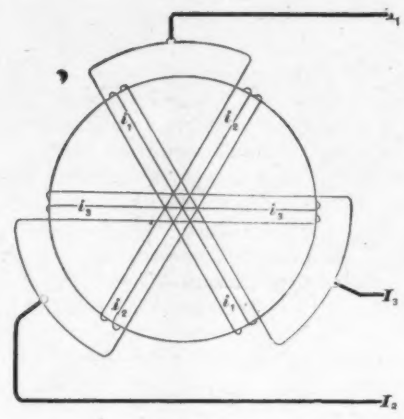


FIG. 2.

be made on account of the loss of potential in the coil in case a current flows through it, the E. M. F. and the magnetism are inseparable in their respective values; they are in some respects equal.

This is the first and most important law on the alternating current practice. I am sorry to say that is too often neglected. In applying this law it must not be omitted to make the proportionate correction in the volts as soon as the product of the current and resistance becomes perceptibly large. Generally this correction will be only small in apparatus if the principal purpose is not their heating after Joule's law. If the coil is connected to an alternator then the alternating magnetism will correspond with its tension, or, as I prefer to call it, the magnetism is in equilibrium with that E. M. F. If no lines of force from an outside source are furnished to the coil and the same is connected to an E. M. F., then the current produced in the coil is of such strength as will create at once the necessary magnetism. If the magnetic resistance of the apparatus is small then few ampères will suffice; if the magnetic resistance is larger then the current will also increase, but in every case the magnetism is the same. (I repeat, the small correction for the loss in E. M. F. excepted.) If, however, lines of force are furnished to the spool from outside then the currents need not increase to the above value, it may become zero or even negative, but if lines of force are furnished from outside, reversed to the normal direction, then the current must increase in order to keep up the former above magnetization, as it happens, for example, in transformers. Is the magnetism sinusoidal in its variations, then the sine also follows the law, and vice versa. The phases of the magnetism are 90 degrees, or one quarter, behind the phases of the E. M. F., because the E. M. F. is a function of the speed with which the magnetism alternates.

Fig. 1 shows that the magnetism changes its strength quicker at the moments $A\ C\ E$ than at the moments B and D, consequently the maximal E. M. F. appears at the moments $A\ C\ E$. The E. M. F. and the magnetism are therefore not only quantitatively but also qualitatively (according to the form of the curve) inseparably connected. That is the second important law. As the form and time is given for the E. M. F. then the same is at once known for the magnetism, and vice versa. If E. M. F. is furnished to the spool, then such a current is created (in strength, form and phase) as will produce the necessary magnetism. I repeat that the correction for the loss in E. M. F. caused by the resistance of the coil is not considered here because that correction can be made later when necessary and likewise other losses of energy, as follows, will have to be considered. An interesting consequence of the above is that in case there are no disturbing secondary phenomena, as loss in tension, etc., and if there are no lines of force from the outside, then the current will lag behind the tension in its phase by 90 degrees. This is shown by Fig. 1 with the consideration that the current and the lines of force produced by it must naturally coincide in time. This which lags by 90 degrees in its phase behind its E. M. F. does not represent work done but it represents only oscillating energy because it is half of the time in the same direction as the E. M. F. in a dynamo, and the other half of the time in an opposite direction. This current does not produce available watts (is the wattless current) because it is used exclusively for magnetization. I prefer to call it the "exciting current." If, on the contrary, the alternating current does work only without creating a magnetic field, or in case the latter is infinitely small, then it can be easily proven that the current will not lag in phase behind its E. M. F. In such cases the effect can be measured exactly as is done with continuous currents, as $r\,i^2$ or $\frac{e^2}{r}$ or $e\,i$ as soon as $e \times e$ are accepted as the effective current and E. M. F. A current which does not lag in phase behind its E. M. F., which consequently represents fully the consumed energy and the respective work, I prefer to call the "watt current." In practice neither the "exciting current" nor the "watt current" are separately possible; there is no apparatus which will not consume watts when current circulates in them and there are no currents which are not accompanied by a magnetic field; it is possible to approach the extremes very closely, but they cannot be reached. Every alternating current can be looked at as a combination, as the resultant current from an "exciting and a watt current." These two currents differ from each other in phase by 90 degrees and give a resulting current of some intermediate phase. It is simple to prove that the two currents can never be added as two rectangular forces. Let the exciting or magnetizing current be represented by $I\,m$; the watt current by $I\,w$; the resulting or really flowing current by $i\,r$; and the angle α the difference in phase between the current and the E. M. F. An example will better illustrate this. Suppose a wire is wound around an iron ring and an alternating current of, say, 100 volts is passed through. By measurement a loss of, say, 140 watts has been ascertained in the iron, the result of the Foucault currents and hysteresis from the resistance of the wire 0.1 Ω and the current 10 ampères, it is seen that the loss of watts in the copper is 10 watts. The total consumption of energy is therefore 150 watts. This gives at a tension of 100 volts a watt current of 1.5 ampères. If we construct now our rectangle (with these data) then $s\,w = 1.5$ ampères, $s\,r = 10$, and we find $s\,m =$ about 9.9 ampères, as that current which furnishes the necessary ampère windings. The apparatus receives accordingly 10 amperes × 100 volts, it consumes 150 watts and causes a difference in phase of about 81 degrees. If we cut a piece out of the iron ring so that by interposition of air the magnetic resistance is doubled, then we need for creating the same magnetism not 9.9 ampères, but 19.8 ampères. The loss in the copper will be about 40 watts, instead of 10 watts as before, because we have now in a round number a current of 20 ampères. The loss in tension caused by the stronger current will be two volts, instead of one, and consequently the magnetism is reduced about one per cent. as compared with before. We have then approximately a loss of 138 watts in the iron and of 40 watts in the copper—a total loss of 178 watts, which represents at 100 volts a watt current of about 1.78 ampères. We then get as resulting current 20.6

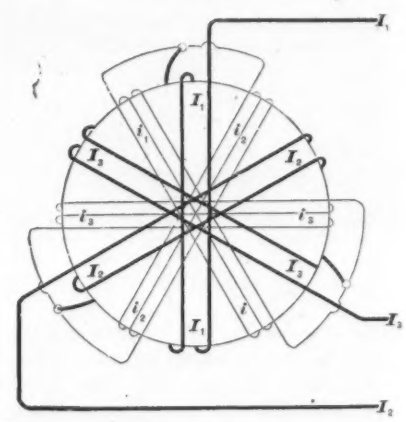


FIG. 3.

ampères, and a difference in phase of 85 degrees. If we want to be exact we ought to calculate once more and insert 20.6 ampères, at that loss in the copper, instead of the rather assumed 20 ampères. By this we would come nearer to the exact truth, but this correction will have little influence on the total result.

From that we learn that if the magnetic resistance is known (this can approximately be determined graphically), and if we know the ampère windings, that is the exciting current, if we know the losses in the apparatus and judge about, or figure out, the watt current, then we find, by the plainest and most elementary mathematics, both the resulting current and the difference in phase. It is quite true that there are at the beginning of the construction of an apparatus several unknown data, but by approximate calculation, and by division of the differences, we reach soon a satisfactory result. By some exercise and experience in such trial calculations, we learn soon to approximate several data before beginning, we soon learn to get along quicker and with less trial calculations. First we need a rough approximate calculation, which is to be corrected by and by. A satisfactory result is reached that way quicker and

* Paper read in Section 2 of the Electrical Congress in Frankfort, Sept. 11, 1891.

surer than by purely mathematical or graphical methods, by which an important factor may escape attention, or a small mistake made at the beginning may spoil the whole work. The calculation of most of the apparatus for alternating currents, for instance, of transformers, and the determination of how they will act under different loads, is, according to the method roughly indicated, a very simple matter. For the calculation of the "exciting current" it is, of course, necessary to determine the permeability curves of the iron, if it is not preferred to use Hopkinson's curves. It is further necessary to understand the calculation of the hysteresis from the quality of the iron, if Ewing's numbers with certain co-efficients are not used, which does, however, not complicate the mode of operation. If we would also introduce with condensers the electrostatic strength of the field or lines of force, the electrostatic permeabilities, the charging current and so forth, then we would be able to solve by the simplest means the technical problems of electrostatic induction with alternating currents.

The question is often discussed whether alternating current dynamos must have much or little self-induction, or whether self-induction is not a great drawback with alternators. Formulæ were laid out to test the conditions under which alternators might be used in multiple arc. Gentlemen, these questions were, from the technical point of view, asked wrongly, and still more wrongly were they answered. The self-induction and the ordinary induction are one and the same thing. It is all the same to the coil whether the magnetism is created by its own current or whether it is created by current from outside. It must be decided from case to case how that has to be arranged.

If a dynamo is to be constructed for nearly constant potential at varying loads, then care must be taken that the number of lines of forces in the windings of the armature remain as constant as possible. The lines of the fields must be prevented from being blown aside by the windings of the armature, and the lines of force of the armature current must not appear in too large numbers. The magnetic resistance for the lines of force of the armature must be made large, and the number of ampère windings upon the armature must be small.

If, on the contrary, a dynamo is to furnish a constant current, then care must be taken that the reaction in the armature is as great as possible or one must make use of the trick of having only a small magnetic resistance for the lines of force in the armature; by this the armature current induces automatically opposing lines of force.

If an electric motor is to be prevented with an increasing load from allowing the necessary quantity of current to pass, then it must be made easy for the lines of force in the armature to pass, which will cut off current. But if the motor is required to allow the necessary quantity of current to pass with an increasing load, then the useful lines of force in the fields must remain there in overpowering quantity, while all others must be suppressed as far as possible. It is rather singular to speak about the difficulties of the multiple arc system, because that system is not used with constant current machines, but only with constant potential machines; the former machines can furnish but a little more than the normal current even on short circuit. Every alternating current machine which is constructed so that its potential changes but little at varying loads, that is a machine which works rationally and economically, can be used in multiple arc. The lower the resistance of the armature and the fewer the useless lines of force which strike the wire of the armature, the greater is the synchronizing power. The synchronization consists simply in making it possible for the machine to increase or decrease its load as the case may require. Whether this is done by a trifling change in the difference of phase of the current from self-induction or by reaction in the armature is not of so great importance as the proper selection of regulators for steam engines or turbines.

These regulators must allow an increase of the load when there is a decrease in the speed. All alternators to be used in multiple arc must be started by motors which have the same percentage of "drop" in the speed, as the English call it.

The problem of the synchronous alternating current motors can also be solved in the following way: When a machine is to be used as a motor then it must receive all or most of the time a current which is opposed to its own E M. F. This can be done with good machines at the expense of a slight displacement of the phases (by mechanical displacement), by which the armature windings weaken the field slightly, or it can be done electrically by self-induction. The rather uneconomical working with abnormal conditions of phases is to be avoided if the magnetic field is regulated down in proportion to the load. If with synchronous motors the field is changed by regulation with the hand or automatically until the current is minimal in the armature, which represents the most favorable phase, then an alternating current machine can be used economically as a motor and does not fall out of step. I point out once more that with good machines which have little drop in potential regulation of the field need not be made on account of the small reaction in the armature, because the necessary current can easily be made to pass. The above explanation refers as well to one-phased as to poly-phased machines which are excited by a continuous current, because there is no difference in principle between these machines. The transmission of power by means of synchronous alternating current machines need not to be uneconomical, as is often asserted, for the losses in alternators are of exactly the same nature as in continuous current machines; they may be built like continuous current machines as much as possible. A carefully constructed alternator has the same hysteresis, the same excitation and the same resistance in the armature. These losses may even be reduced, because the conditions which insure sparkless operation of the continuous current machines do not coincide with the conditions necessary for the highest economy. As the transformation causes but little loss, therefore, it is always possible to build machines for low potential in which but little space is lost through the insulation of the copper bars. As the same copper in the armature gives better results in a poly-phased machine than in a few-phased machine, so the future belongs decidedly to the poly-phased, low potential machines. A look at the 300-h. p. dynamo constructed by my friend C. E. L. Brown will show you how small and effective such machines can be built. With reference to the unsynchronous, especially the so-called rotary current motors (drehstrom) which were first suggested and used by Tesla and Ferraris, I believe, I am able to state that I have succeeded in making them very economical and practical. The construction of these motors has been often described in various periodicals, and I take it for granted here that it is known to you. Yet some of the principles of construction may be of interest to you. An unsynchronous motor consists chiefly of a ring-drum, or disc-shaped magnet, whose windings are arranged as symmetrically as possible around it analogous to the armatures of continuous current machines. The different coils or sections are fed by succeeding phases of the current, and the rotary magnetic field in such a way created puts an armature with short circuited windings in almost synchronous motion. If the number of phases is small, then pulsations will arise in the magnetic field, as I have expressed long ago. I shall try to prove that, and more, because that point is still often discussed up to date. A magnet symmetrically made in all its parts can, with its magnetic axis in every possible position, retain the same magnetism as to quantity and distribution only when the same magnetizing power is present in each position. This condition is not sufficiently fulfilled in two-phased machines; three or other poly-phased machines are better. The law pointed out especially at the beginning teaches us, furthermore, that every E. M. F. balances an exactly fixed (corresponding) magnetism: and as in few-phased motors the total of the E. M. F. is not quite constant, so the magnetic field cannot be free of pulsations. The electric energy in watts, transmitted by a bundle of rotary currents, is further not absolutely constant in few-phased motors; it comes nearer to perfect constancy proportionally to the increasing number of phases. It follows from that that the work of the motor and the start must be pulsating, of course only when the field is pulsating. The rotary current motors which are built at the works of the Allgemeine Elektricitäts Gesellschaft are accordingly poly-phased motors; they possess valuable features which I have repeatedly described and which I shall have the honor to show you when we inspect the transmission of power from Lauffen to Frankfort. The action of rotary current motors is, as you may have supposed, analogous to that of transformers; both have two windings, one for the introduction of current and one for induction, but as the two are on separated opposite iron parts there results a greater magnetic dispersion, as in transformers. To diminish proportionately this dispersion we are forced to work with a larger number of phases, that is with more iron and less copper. By that the hysteresis is increased, which, together with the friction (of air and mechanical), prevents these motors from working as economically as is possible in transformers for alternating currents. At all events the efficiency is, when the motor has proper dimensions, just as high, if not higher, as in the best continuous current motors. The speed is best regulated by putting variable resistances in the secondary circuit; by these resistances only the strength of the secondary current is reduced and not the strength of the magnetic field. All phenomena are less complicated and can be easier controlled when we try to get the tractive power from a weak current in a strong field and not from a strong current in a weak field. This has moreover an analogy in the continuous current machines.

As to the most favorable number of periods of the current, narrow limits cannot be drawn. I prefer to work rotary current motors with as few periods as possible, about 30 to 40 per second, so that, with an ample quantity of iron and lines of force, a sufficient number of windings are left and the exciting current remains small. In cases where the strength of the wattless exciting current is of no special importance a higher number of periods may be taken. I shall leave the explanation of single points to the discussion which I suppose will follow, and in conclusion I will speak about the method by which I drive motors with the double number of phases from three leads, in which flow three currents with difference of phases of 60 respectively, 120 degrees, because that method has not yet been published. Fig. 2 shows a plain three-phase drum. The currents i^1 and i^3 have a difference of phase equal to 60 degrees their sum; the current I^1 has an intermediate phase and a 1.732-fold strength (2 sin. 60 degrees). If we wind the lead which carries the current I^1 upon the drum between the coils i^1 and i^3, and with corresponding number of windings, then we get a current of a middle phase and of same ampère windings. If we do the same with the leads I^3 and I^3 then we get a drum as shown in Fig. 3. The number of currents and phases is double that in Fig. 2, but the number of leads is still the same, that is only three.

It is clear without further explanation that this method holds good also for any other number of phases. I beg to take notice that the windings on the two kinds of coils need not be adjusted too exactly in equality, because we have here only two rotary current systems wound between each other, the pulsations of which are mutually interfering. The arrangement causes much less pulsations, even when not so great care is taken, than in a plain three-phase system. The 2 horse power rotary current motor in the exposition exhibited by the A. E. G. was of late changed to a poly-phased motor. It showed at once the great advantage of the poly-phased type.

I must offer an apology for the length of this lecture and request those who are specially interested in the rotary current system to put any question about that system as well as about its special application in the transmission of power from Lauffen to Frankfort. Any desired information will be cheerfully given.

Electric Railroads for Rapid Transit Between Cities.*

BY CARL ZIPERNOWSKY.

INTRODUCTORY.

The need of some means for increasing the speed of trains between cities, above that which can be accomplished by the present railroads, is becoming a question of such importance that it is now only a matter of a short time before something will be done, and it is for this reason that we have occupied ourselves with a proposed electrical railroad to accomplish this object.

All persons who have much traveling to do will appreciate the great loss of time while on the road. To increase the speed of the present system of railroads above 100 kilometres (62 miles) an hour may be excluded as impracticable. The reciprocating motion of heavy parts of express locomotives gives rise to oscillations which greatly strain the rolling stock as well as the roadbed. For this reason the present system of steam locomotives is limited as to maximum speed. With electrical motors there are no reciprocating parts, and the limitation of the speed due to the reciprocating motions does not exist; the speed can, therefore, be increased above the present limit without increasing the strain on the rolling stock or the roadbed. The electrical locomotive needs no coal, no water, no tender, no generator of power, only a motor whose rotating parts are directly on the axles.

The electrical railroad has these advantages: it offers the possibilities of a new system of transit which, owing to the great increase of speed which it admits, adapts itself particularly well to the rapidly increasing demands for rapid transit. As soon as the possibility is shown, the working out of the details will soon follow, as the very rapidly increasing demands of commerce make it necessary that everything possible be done to accomplish this end, and it is certain that within a few years such railroads will be built between some large cities, which are closely connected commercially. It may also be predicted that whole continents will be crossed by such railroads.

We chose for our project the two chief cities of the Austrian-Hungarian empire, Vienna and Buda-Pesth, not only because there is a very large intercourse between them, but also because this lies on the thoroughfare between the centres of the oriental and the western countries. An electrical rapid transit road between Buda-Pesth and Vienna will form the beginning of a through line from the east to Paris and Havre on the one hand, and to Berlin and Hamburg on the other.

This projected road is furthermore particularly well adapted for an experimental road, as it introduces all the difficulties encountered in building such a road through different kinds of country. The crossing of the wooded hills of Bakonyer, the very low islands of a branch of the Danube, and the hilly country between the Danube and the Leitha Mountains, gave us the opportunity to show how we would build such a road over flat lands, hills and through mountains, and what fundamental principles we would lay down.

Before going into this, we wish to mention that, from the nature of such a system, there would not be trains of cars at long intervals, but on the contrary single cars for few persons, following each other in quick succession. This is preferred not only in order to have frequent connections between the cities rather than occasional fast trains carrying many people, but more particularly for technical reasons, namely to have the greatest economy in the power used per car, and to equalize as much as possible the consumption of power over the whole line. The smaller the weight of a train, the smaller will be the motors, the smaller the current consumed per train, the simpler, surer and cheaper will be the leads. The smaller the units, the surer and the more profitable will be the working of the system, because one can prepare for the variations in the "traffic" during the day, and can thereby

*This paper, read at the general session of the Frankfort Congress, Sept. 12, being one of the most interesting to Americans, it was thought best to give it here in full.

always obtain a more favorable relation between the dead and the live loads. Small units at short intervals have the additional advantage that the leads are more equally loaded than they would be with long heavy trains. The utilization of the leads and the machines becomes more nearly constant, and the whole plant will be more efficient. The increase in the number of employés necessitated by such a system is negligently small as compared with the very greatly increased cost which would be necessitated by running the plant under unfavorable circumstances. These are the reasons which have led us to adopt this tramway system in preference to the usual railway system.

In order to design the cars and roadbed it was necessary first to determine upon the speed, the shortest time intervals between the trains, the number of passengers and the nature of the cars, and to base on these values the size and shape of the cars, the power required and the size of the motors, the total weight of a car, the roadbed, the method of distributing the current, etc.

As to the speed, we wish to reach the maximum which appears to be possible to attain with simple adhesion and a modified roadbed. The speed can be increased only up to the limit of the strength of the materials, especially of that of the wheels. This limit is shown by calculation to be about 250 kilometres per hour (155 miles per hour, or about 2½ miles per minute). The circumferential speed of the wheels of 2.5 metres (about 8 feet 3 inches) diameter becomes so great, being nearly 70 metres (229 feet) per second, that the bursting due to centrifugal force comes into consideration. It may be shown that even with wheels made of discs it is not safe to exceed the circumferential speed of 70 metres per second, as even the best materials at our disposal do not allow a sufficiently large factor of safety against rupture.

The adhesion also limits the speed to which we may go in order to be able to propel the car with sufficient reliability. But this limit cannot be readily determined, as the grades, nature of the materials, weather, and similar factors vary very greatly. It is not possible to determine, therefore, the speed at which propulsion is still possible, and we are compelled in this case to make an approximate estimate on the basis of the greatest grades.

We will assume that the maximum speed attainable with single cars is 250 kilometres on the level and 200 on the grades. The intervals between the cars will be regulated by the traffic and the size of the car. Here, too, there is a limit due to safety; no car should follow another at a less distance than that at which it can be brought to a stop if something should delay the one ahead. The stopping and signaling evidently depend on the facilities provided for this purpose. If we were to employ for such rapid transit the same system of signaling as on the present roads at 100 kilometres speed, we would run the risk of their failing at this high speed, at which both seeing and hearing are rendered difficult and unreliable. It is, therefore, necessary to adopt an entirely new system of signaling specially designed for such speed. Furthermore, there must be provisions for the case that the signals should fail to be seen from the car, in which case the signaling station must be able to stop any car even without any further signaling, which is easily accomplished on electrical roads by simply introducing switches controlling the main current. The cars may be said to be controlled from the outside as in the case of pneumatic tube projectiles.

The minimum interval between cars, therefore, is determined by the condition that a car cannot move any farther, by virtue of its momentum and a possible grade, after the current has been turned off, than a certain minimum distance which must be kept, for safety's sake, between it and the preceding car, even when at rest. This distance can be made less the better the braking facilities on the car, and the surer the engineer is to notice when the current has been cut off by the signaling station. It is evident, therefore, that the smallest interval between cars can be determined only in connection with the braking facilities, but it should not be made less than 10 minutes. This minimum interval is, of course, only for those hours of the day when there is most travel.

The capacity of the cars must be such as the densest traffic demands, but on the other hand the cars should not be any larger or heavier than is necessary, for reasons already given, for which reasons it would also be inadvisable to couple several cars into a train. The determination of the dimensions of the cars is difficult to make until one has had experience in how far the public would patronize such rapid transit. But we believe that it is safe to estimate 40 seats to a car, and intervals of from 10 to 60 minutes. During the times of greatest travel 200 persons could be carried per hour, which surely is considerable; during the times of least travel this would be reduced to about 50 per hour.

Besides the transporting of passengers, such a system would be of great use for the mails. The transportation of freight other than the small baggage of the passengers can hardly be considered, as the cost per pound would necessarily be too great for any but very exceptional cases; even for heavy baggage it would hardly pay.

The two generating stations are intended to be in the cities Banhid and Zurndorf, which are about 60 kilometres from Buda-Pesth and Vienna respectively. From there currents of 10,000 volts are to be sent along the whole line on poles, from which wires branch off to secondary stations all along the roads, which are at the same time signaling stations. In these secondary stations this high tension alternating current is transformed into one of lower tension or by means of one of our transformers into a continuous current. It will depend entirely on the results of some experiments with the motors for the cars which of these two currents will have the preference.

CONSTRUCTION OF THE CAR.

The car was constructed in the car factory of Ganz & Co., of Buda-Pesth. It contains 40 seats for passengers, two toilet rooms and some available spaces for the mail. It is 45 metres (148 feet) long, 2.15 metres (7 feet) wide, and 2.20 metres (7¼ feet) high; the two ends are shaped somewhat like a parabola, in order to reduce to the smallest posible amount the air resistance, which at such speeds absorbs the greatest part of the power.

The two ends of the cars are exclusively for the motors, and are inaccessible to passengers. They are separated from the main part by partitions with doors and windows. They must also be separated from the engineer's stand, on account of the very violent currents of air which are generated in this space. Each of the motor rooms represent a separate truck.

The framework of the car is a system of beams which rest on the two motor trucks, and in the body of the car form a sort of truss bridge, with cross braces at every 1.5 metres. The bridge construction adapts itself best to the conditions. The body of the car rests on the two pivoted trucks and is supported by 16 pairs of evolute springs, which are held in cast steel telescopic cases. The support is such that both trucks can turn, corresponding to a curve of 1,000 metres radius; the side motion of these cases inside of the rails is in that case 6 millimetres.

Each truck has two axles, and each axle has its motor, making, therefore, four motors to a car. The magnets are secured to the frame of the truck, and the armatures are directly on the axles. The driving wheels (all of the four pairs of wheels of a car are drivers) were made as large as possible, and have two flanges, the outside one being merely for safety sake against derailing, and is 5 millimetres distant from the edge of the rail. The inner flanges also have 5 millimetres' clearance, to allow for the heating and the expansion of the axles.

The wheels are made of two solid conical discs secured on the outside edge to the tires in such a way that the tire is readily replaceable. On account of the great strain on the tires they must be very carefully made. The bearings are of special importance; the pressure on the wheel being nearly 7,500 kilogrammes and the speed 600 revolutions an entirely new construction was chosen. The bearing boxes are solid, notwithstanding the attending disadvantages.

In the exact middle of each truck there are two contact wheels which run on separate rails carrying the current. These wheels are flanged so as to be guided by the rail; it is very important that they be exactly in the centre and that their axial motion be as little as possible. As the currents are necessarily quite great the nature of these contacts is a very important matter.* The contact wheels must have a large diameter in order not to have too great a speed of revolution, which would introduce difficulties at the bearings; they must, furthermore, be light, so as to follow any motions readily and must rest on the rails with some pressure. We have made them similarly to the driving wheels, of two steel discs secured together holding a readily replaceable tire of bronze. The three bearings of each of these contact wheels are secured to the truck by means of three pivoted arms and pressed on to the contact rail by means of three vertical springs. The current is taken off of these wheels by means of massive copper blocks which rest against the wheels. Their shafts are made of two parts and insulated in such a way that neither the shaft nor the bearings carry current. The contact wheels and electric motors are accessible from a narrow bridge which runs the whole length of the motor room above the axles.

The braking mechanism must be particularly well designed, as it is of vital importance for safety's sake, with a speed of 250 kilometres an hour, to absorb or destroy a momentum representing 60 tons in the shortest possible time, and thereby to stop the car. The air friction itself acts as a powerful brake, being equal to about 200 h. p. On the level all other resistances are very small as compared to that of the air. It is evident, therefore, that the first braking action on stopping the current will be that of the air. But this applies only to the first moments, as its action diminishes very rapidly as the speed becomes less. A second powerful braking action may be produced by connecting the terminals of the motor to a resistance, which may be put under the bottom of the car, and to let the motor act as a generator. It is immaterial, as far as the necessary switching arrangements are concerned, whether continuous or alternating currents are used, and no difficulties present themselves. As the speed diminishes to about a half, the motors which were originally in parallel should be capable of being connected two in series and two in parallel, and at, say, one-quarter speed all four in series.

This braking action, although effective, is not sufficiently powerful for speeds below 30 kilometres per hour (about 18 miles). There must be an additional mechanical brake, for which we prefer the usual Westinghouse air brake, as the safest and quickest. For this purpose there are two air chambers and eight cylinders on the car. The dimensions, capacity and pressure from these are quite ample, and the loss of pressure can be replaced either by hand or by means of a small electric motor. The two reservoirs are made of 4-inch pipes, each 30 metres (96 feet) long.

The car is equipped with air buffers, the heat generated by their action being used to generate steam which is then allowed to escape. The cars furthermore have couplings so that a disabled car could be drawn by another. The headlight for the night must be so arranged that it can be directed. The illumination of this must be so powerful that any obstacle, as for instance a fallen tree, can be seen at a sufficient distance to enable the car to be stopped. This distance will be about 2 kilometres (1¼ miles); the headlight reflectors will, therefore, have to enable one to see even in bad weather at this distance.

The illumination of the car is to be effected by means of incandescent lamps supplied from the main current, through a special apparatus which equalizes the variable potential. The heating is by means of two coal stoves, which may be placed between the two walls. The windows have double panes of glass and are arranged so that they cannot be opened. Ventilation is effected by suitable pipes on the roof of the car.

CONSTRUCTION OF THE ROAD.

In the above we have endeavored to give the general principles of our projected system which form the basis on which to work, namely the mode and the means for a system of rapid transit. We will now consider the conditions which are thereby necessitated concerning the construction of the road itself.

As already explained, the grades at such a speed of 200 kilometres do not offer as many difficulties as the curves. In order to mount grades with greater speed requires merely a greater power and it can always be so arranged that this increase of power can be obtained at the proper places. The speed is limited on the curves, for which reason only curves of large radius can be used. For that part of the road over which cars are to be run at full speed we have limited ourselves to curves of not less than 3,000 metres radius (9,840 feet); where the nature of the land does not permit this the speed will have to be diminished. The side pressure on the curves is to be avoided entirely by raising the outside rail. By this we mean, of course, that the difference in height of the two rails is obtained partly (one-half) by a lowering of the inside rail and partly (one-half) by raising the outside rail. The difference in the heights of the two rails for a speed of 200 kilometres and a curve of 3,000 metres radius is 148 millimetres (5¾ inches), at which the resultant of the centrifugal force and the weight is normal to the rail. The greater this difference the more difficult will be the passage from a straight stretch to a curve. It will not be possible to make this difference greater than 180 millimetres (7⅛ inches) without endangering the safety of the passengers at the curves. In laying out the road the curves and the greatest possible speed will have to be considered for each case, taking into account the grade, direction, etc., and the rise of the outer rail determined from this.

The great attention which has to be given to the curves, in laying out the road to comply with the contour of the land, increases the difficulties greatly and for this reason one should not be too particular to avoid grades. In our projected road from Vienna to Buda-Pesth, we have not hesitated to use grades of 10 per cent., and we assume that the speed on these grades shall not be less than 200 kilometres (124 miles); the power, however, will be twice as great as for the same speed on the level. Steeper grades than 10 per cent. would increase the weights of the more powerful motors to an unfavorable degree, and they are, therefore, to be avoided if possible; if they cannot be avoided the speed on these grades will simply have to be reduced.

It will be seen from the above that the average speed in hilly and mountainous districts will not be more than 200 kilometres (124 miles) per hour; on down grades and on the level the time lost on the curves and up grades is made up by a maximum speed of 250 kilometres (155 miles).

Having now considered the laying out of the road we next take up the construction of the road itself, which is so intimately connected with that of the cars. We are, above all, safe against derailing, on account of the large diameter of the drivers and the nature of the construction of the cars, whose pivoted trucks can be guided so much better (having but five millimetres or three-sixteenth inch play) than is possible with the usual rigid shafts.* Furthermore, the great length of the car is the best means for preventing the lateral motions of the car, and thereby avoiding the chief cause of derailing. A second safeguard is secured in the second flange on the drivers, both of which are furthermore made 50 millimetres (two inches) high. Finally, to guide the car in case the wheels should leave the rails, we have provided that the frame work of the car extend down outside of and below the top of the rail. Besides this, the body of the car is carried so low that the distance to the current carrying rails is only 100 millimetres (four inches), and therefore in case of derailing, these rails would still act as a sort of guide and support for the car.

But the best protection against derailing is the particular roadbed and rails which we have chosen. The latter is a 180-millimetre (7⅛ inch) high Vignol rail, weighing 50 kilogrammes per metre (about 33½ pounds per foot), which is screwed down to cast steel sleepers by cast steel supports on both sides of the rail. The latter have their surfaces planed

*The author of the paper did not explain in detail why he preferred a rolling contact to a sliding one; it would have been very interesting to have heard his reasons. Carl Hering.

*The usual railroad cars in Europe have no trucks, being built more like the American horse cars. C. H.

and grooved so as to assure the proper width of gauge beyond question. They are placed at distances of 1 metre (3¼ feet) apart, and are bolted down to a continuous foundation of concrete. The rails are supported along their whole length on the foundation, so that in case of a rail breaking it is still held in place. The current rails are constructed as a sort of air line, supported on insulators about 500 millimetres (20 inches) from the ground, by means of cast iron carriers held in supports cast for them in the steel sleepers.

The whole roadbed must be constructed with the utmost care and precision even in the minutest details and the rails must be screwed to the foundation. Such a construction, on a continuous foundation, increases the cost of the road very greatly, but we consider this as unavoidable, on account of the great necessity to guard against all sources of danger. It is above all the weight and stability of the roadbed which insures safety. It is out of the question to make the bed of loose stones, as this is altogether too elastic. Almost all the cases of derailments can be traced back to changes in the bedding; most of the accidents which have occurred can be traced to unequal settling of the roadbed, and similar causes. In our system there is furthermore another reason for having a very heavy, massive roadbed; the shock or blow which such a heavy car exerts at that great speed must be met by some correspondingly heavy and massive body, and only then will the roadbed stand the strains without danger. The car must roll perfectly quietly on its absolutely solid foundation.

The desired rigidity is secured only when the rails and sleepers are actually bolted to the foundation. This foundation may be made of two continuous underground walls of masonry; where the road has been filled in, these walls must be made much stronger than in cuts or where they are built in the natural ground. For that reason there should be no high embankments, as they keep on settling even after several years, and therefore do not offer a sufficiently secure foundation. For bridges the conditions of the road are more favorable than for steam roads, as it is necessary to consider only the maximum weight of two cars passing each other, say about 120 tons; the rigidity must, however, be considered on account of the violent action, almost like a blow, which such a rapidly moving car exerts. Stone viaducts will be found to be necessary much more frequently than for steam railroads, partly because, as we have mentioned, high embankments cannot be relied upon as sufficiently safe; partly, also, because the former will be cheaper than the latter. The reasons for this are, that for such a system of single cars instead of trains, long roads must unquestionably be built with double tracks, as turnouts are out of the question, partly because of the loss of time, which is just that which our system is intended to avoid at all costs, and partly because switches would have to be traversed at great speeds, which would heighten the source of danger very greatly. Anything but a double-track road is therefore entirely out of the question, except on very short roads on which there is only one car at a time. The two tracks must be at least 10 metres (33 feet) apart, on account of the intense air currents and air friction, the shock from which might become a great source of danger at a smaller distance than this. With a distance between the rails of 10 metres, a high embankment would become so very expensive that its cost would be greater than that of two independent parallel viaducts 10 metres apart. We proposed for the latter to use the best construction of cement and iron on piers with spans of 12–15 metres (40–50 feet), and a width of 2½ metres (8¼ feet). We have found from calculation that for the line from Vienna to Buda-Pesth such viaducts are not more expensive than embankments when the height of the track above the natural surface of the ground is 6 metres (19¾ feet), even when the wide space between the two tracks is not filled in.

The road, of course, must be made inaccessible to all pedestrians except the railroad employés. Grade crossings are out of the question. To save the trouble of clearing away the snow, we propose to elevate the top of the foundation of the roadbed 500 millimetres above the lower level of the road, in order that the snow may be partly, at least, blown away by the intense current of the air accompanying each car.

As already mentioned, great attention must be given to the signaling. As it may be necessary that the signaling station has to stop a car even when the locomotive engineer has failed to see the signal, all signaling arrangements must be so designed that with each signal the current supplied to the rails must be correspondingly turned off or on by the signaling station.

To accomplish this we lay down the following conditions:

1. Along the whole line signaling stations must be erected, which for a double-track road must not be at a greater distance apart than two kilometres (1¼ miles).

2. The rails carrying the currents for each section must be cut and insulated from those of the next section; the leads supplying these sections at these places must pass through a controlling and regulating device.

3. This device must show when the current is greater than the normal, by reason of two successive cars being closer together than the normal distance, and it must furthermore diminish the current for the second car, so as to compel it to go slower until the distance between it and the one ahead is again normal.

4. Every signaling station must be capable of sending its signals to the two neighboring stations.

5. Every signal should be such that the engineer can readily see it.

6. The signals must be quite long in order that he may see the colors or lights as stripes or bands.

We propose to signal with three bands, having the following significance:*

Three bands, "stop;" two bands, speed of 50 kilometres; one band, speed of 100 kilometers; no bands, full speed.

7. Besides the above there should be signals for covering stations, and a telephone connection between the stations.

POWER REQUIRED.

The power required for propelling a car of about 60 tons, and having a cross section of nearly 5 square metres (about 50 square feet) is very considerable, and it is evident that the greater part of the power is required to overcome the resistance of the air. In the absence of reliable empirical data regarding the various resistances encountered by a railroad train, we have taken up each of them in series, as far as concerns the scope and object of the present project, and give the results here as follows:

The air resistance was determined lately by Crosby (see THE ELECTRICAL WORLD, 1890, vol. XV., p. 346) to obtain a safe basis for calculating the projected rapid transit road from New York to Chicago. He obtained figures for the moving of differently shaped bodies in air, which are considerably smaller than those of the formulæ heretofore used. As Crosby's experiments were made with great care, we can unhesitatingly use his empirical formulæ for the resistance of air at the face of the car, namely:

$$P = 0.1441\ V$$

in which P is in pounds per square foot and V the velocity in miles; and

$$P_{,} = \frac{P + \cos.\ \theta}{2}$$

for the pressure against surfaces moved at an angle.

According to these formulæ one can assume that the air resistance of a well-constructed car for 200 kilometres average speed will not exceed 250 h. p. If steep grades (10 per cent.) are to be ascended at this speed, it will require for a car weighing 60 tons nearly 450 h. p.

To this must be added the resistance of curves, the air resistance on the lateral surfaces, the rolling friction, bearing friction, loss of power by lateral oscillations, etc., which, however, cannot be calculated for want of experimental data, but which are no doubt quite small as compared to the others, and may, therefore, be safely estimated at 100 h. p.

The maximum power required for a car is according to this 800 h. p., and every car would, therefore, have four motors of 200 effective horse power each. Each car will, therefore, require in favorable weather about 260,000 watts when the road is level, and up to 600,000 watts in ascending grades.

The voltage of the working current could not be chosen higher than 1,000 volts, as interruptions and complications are too apt to be caused by poor insulation, etc., at higher voltages than this. Besides, all parts of the circuit on the car should be capable of being handled without danger to life.

The amount to be transmitted to the moving car must therefore be from 260–600 ampères, which requires very good contact surfaces.

We may assume that the above problem may be considered solved, as far as the railroad engineering is concerned. There remains to be considered what the best means are for the electrical transmission of the power. We reserve this question, however, for our reconsideration in view of the results which are to be obtained from some experiments which we are at present making with a new form of motor specially designed for railroad purposes.†

A Solution of the Block Signal Problem.‡

BY H. WARD LEONARD.

The attention of the public has been forcibly attracted of late to the importance of efficient automatic block signals by the recent terrible accident in the heart of New York City. Either the failure of the signal or the failure of the engineer of the following train to observe the signal was the cause of this, as has been the case in many other similar accidents. The purpose of this article is to call attention in a cursory manner to the state of the signaling art, and to indicate, if possible, the lines it will be necessary to follow in order to make a thoroughly reliable and practical block system for railways.

A careful study of the whole subject, with the help of some recent publications too lengthy to be condensed within the limits of a magazine article,—including a series of articles in the *Railroad Gazette* compiled in a volume entitled "American Practice in Block Signaling," and a paper read by G. H. Paine before the New York Railway Club on April 16, 1891—leads to the following specification indicating the desirable features of an automatic block system:

1. There should be signals both on the train and along the track.

2. The signals on the train should give a continuous and positive indication to the engineer.

3. The signals both on the train and along the track should be actuated from a source of energy constantly under the observation and control of the locomotive engineer.

4. The signals should be distinctive both by form and color, and should be audible under certain instances when desired.

5. Any two trains on the same block should each give a danger signal to the other.

6. The power of actuating the signals should be positive, strong enough to operate any desired signal, and should not depreciate and require renewal, as in the case of batteries.

7. The operation of the signal should not depend upon the movements of any mechanism beyond the observation and control of the locomotive engineer while at his post.

8. Any train should have to disregard more than one danger signal before being *able* to reach a preceding train.

9. Any locomotive engineer should be able to communicate with any station or any other train in the same block.

10. There should be a signal constantly before the engineer and in the locomotive cab whose indication will always be "danger" unless *all* his signals are working perfectly.

11. The form and color of the signal should change from "safety" to "danger" under the observation of the engineer as the train passes the signal.

12. The absence of any signal should indicate danger, but there should be a positive danger signal which would only and always give positive and continuous indications to both engineers when two locomotives are in the same block.

13. In case of failure of the train or track signals at any point, means should be provided whereby signals could be instantly sent to a following train.

14. A misplaced switch should set danger signals on any train in that block and also along the track in that block.

15. The signals should be the same by day or night, and any light at the signal should always indicate the presence of a locomotive in the block.

16. Any person should always be able to signal danger to approaching or receding trains in that block while it is out of sight and hearing and without any light or special apparatus.

About three years ago the writer suggested a block system, which, it is believed, would comply with the above specifications, and with the hope that it may lead to improvements in practice the following description of it is offered:

Divide the line of the railway into blocks of, say, one mile long. Make each block overlap the next one half way. Stretch a bare wire parallel to the track, and continuous along each block. Thus a wire one mile long will start from the beginning of each block, and another parallel to the first will start at the centre of the first. There will thus always be two parallel conductors along the track, and a conductor will end and a new one begin at each half mile. The forward end of each mile length of conductor will be connected by a wire leading to a green incandescent lamp, and the other terminal of the lamp will connect with the ground. Similarly the rear end of each conductor will connect with a red incandescent lamp.

Upon each locomotive will be placed a generator of electricity of about 100 volts; that is, about the pressure of the incandescent lamps. This generator can be a battery or, preferably, a small dynamo, driven by a small engine which is operated by steam from the locomotive boiler. One pole of this generator is grounded by making contact with the metal work of the locomotive. A conductor leading from the other pole of the generator passes through an ampère meter for indicating the current being generated, and thence on through a low-resistance series incandescent lamp, which when supplied with the current of four of the track signal lamps will operate at a moderate incandescence. After passing through the series lamp, which we may call the pilot lamp, the current passes to a trolley carrying a large wheel made after the style of a bicycle wheel, and this wheel makes rolling contact by a concave rim upon the two parallel conductors stretched along the track.

Now it will be evident that if the generator be operated the electric current will pass through the pilot lamp and up the trolley to the two conductors; thence it will divide equally between the four lamps connected to these two conductors, passing through two green lamps ahead of the trolley, and through two red lamps to the rear of the trolley, the green lamps as well as the red being half a mile apart.

As the train moves forward the trolley will finally roll off the conductor of the block it is leaving, and both the red and green lamp of that block will be extinguished. At the same time the trolley will roll on to a new block and the red lamp at the rear end of this block will light up just as the locomotive reaches it and will then pass the rear. At the same time the green lamp at the forward end on this new block will light up a distance of one mile off.

It will be seen that a following train would have to pass the two red lamps of the preceding train before a collision could take place; also that whenever two trains would get within a mile of each other the generators would be acting in concert to divide the combined loads of the

*We would suggest that it would be more rational to reverse this set of signals so that if the engineer fail to see the signal, or if one or more fail to act, it would cause him to stop or diminish his speed rather than to increase it, as he would with the above arrangement. C. H.

†To the above paper the following additional facts may be added: The gauge of this proposed road is to be 1.45 metres (4 feet 9⅛ inches) the same as that used in Europe at present. The cost of such a road is estimated to be about two and a half times that of an ordinary railroad. The car is shaped somewhat like a cigar pointed at both ends. The seats are like those in the usual horse cars; the entrances are at side doors where the car proper joins the motor rooms. The proposed speed is about double that of a train at present running regularly between Brighton and London, on a 6-foot gauge.

‡Abstract of a paper in the October *Engineering Magazine*, communicated by the author.

two, and whatever the current of each had been previously, it would immediately become different, the generator having the higher pressure taking the larger portion of the combined load. Thus the pilot lamp of one locomotive would flash up and its ampère meter would indicate a greater current than usual, and this by a contact on the ampère meter needle would cause an alarm-bell to ring in the cab. Similarly the pilot lamp of the other locomotive would be reduced in candle power, the ampère meter would show a reduced current and the alarm would ring on the lower contact. At the same time the locomotive engineer of the following train would see before him the red lamps of the preceding train in addition to his own green lamps, and a rear guard on the preceding train would see in addition to the red lamps of his own train the green lamps of the following train. On each locomotive a line containing a high resistance is led from the trolley and around the generator to ground, and this circuit in shunt to the generator contains a telephone. It will thus be possible for either locomotive engineer to talk to another engineer preceding or following in the same block, and regardless of whether either or both are in motion. If telephones in the various stations be similarly connected from the signal conductors, communication can be carried on between the station master and passing trains.

If it be desirable to stop an approaching train it is only necessary to interrupt one of the signal conductors or connect the two together, or ground either. If the conductor be broken or disconnected, the engineer when a mile away finds his pilot lamp dim and his alarm ringing because the current from his generator is reduced by one-quarter.

If a signal conductor be grounded, as soon as the trolley makes contact with that conductor the generator is short-circuited, and its pilot lamp first flashes up brightly and the bell rings and then the current runs down rapidly and the bell rings by the lower contact. If the two conductors be crossed, the load of two more signal lamps is added to the normal load of the generator, and this increase of 50 per cent. in the current makes the pilot lamp flash up and the alarm bell ring, at the same time the engineer sees the red lamp of the abnormally supplied block burning before him.

If a train breaks down its generator, it keeps its trolley on the wires as before, and as soon as it gets into a block with another train its pilot-lamp lights and the alarm rings.

If the other train be preceding, its two rear red lamps also signal danger to the following disabled train, and the engineer of the preceding train also receives a danger signal by its alarm bell and the increased current of its pilot lamp. If the disabled train is followed by another into the same block, an abnormal red signal is set between the two trains, green lamps light up in advance of the disabled train and the pilot lamp and alarm on both the trains indicate danger.

If two trains near each other both had their apparatus broken down, both would, of course, be moving very cautiously and endeavoring to ring the telephone call of any other train which might come into the same block with them.

A misplaced switch would make a contact which would light a red lamp in front of an approaching train.

Now as regards the signals along the track, the incandescent lamps should be arranged in a proper signal box, and the green lamp should show a vertical band of green light, whereas the red lamp should show a horizontal band of red light, thus giving a signal defined by both form and color.

Two possible objections which may be raised against this method of signaling are:

First. The presence of a car on a track without any accompanying attendant would not give a danger signal as it would with a track circuit system. This, however, is a rather remote contingency, and in any event could not lead to an accident with much loss of life. The unreliability of the track circuit is so great in other ways as to make this slight defect almost negligible by comparison.

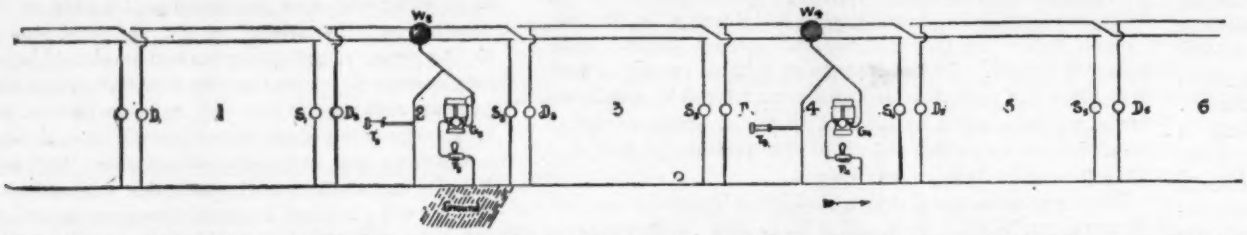
Second. The action of sleet might interfere with the action of the signal by preventing electrical contact between the trolley and wire. This trouble would be rare, in any event, and it is not likely to occur, as the heating effect of the strong current on the wire would tend to eliminate this trouble, just as it does with electric railway systems. If, however, it became necessary to provide against this, it could be done by placing the conductors beneath a semi-circular structure, such as a tube sawed longitudinally and concave downward.

It will be evident by examining the specification as to the requirements of a safe system that this plan avoids the defects of the present system.

The next consideration is as to its first cost and maintenance, and it will be evident that the advantages on these points are conspicuously in its favor, for the simplicity of the signals and the cheapness of the small bare conductor make its first cost less than that of any existing system. The cost of operating will be almost *nil*, as there will be almost no need of inspecting signals, having no batteries, electromagnets, relays, weights, clockwork, compressed air, oil-lamps, or the various other possible causes of failure of the existing systems.

It will be evident that by connecting along the signal conductors white incandescent lamps, and increasing the size of the generator, the track can be perfectly and uniformly lighted both in advance of and behind the train as it moves forward ; and that also all crossings and stations can be lighted while a train is within a mile of them. Two and one-half horse-power would in this way be all that would be necessary to keep the track illuminated by 16 c. p. lamp every 200 feet, and for a space of not less than half a mile in both directions from a moving train.

Trains having an electric plant for illumination of the cars require a plant of about 15 h. p., so that the additional power required in such a case would be hardly worth mentioning, and no special generator beyond that for train lighting would be needed.



D_1, D_2, D_3, etc., are the red lamps connected to rear ends of the sections 1, 2, 3, etc., respectively. S_1, S_2, S_3, etc., are the green lamps connected to the forward ends of the sections 1, 2, 3, etc., respectively. G_2 and G_4 are the generators on trains in sections 2 and 4 respectively. P_2 and P_4 are the Pilot lamps in series with the generators and placed in the locomotive cabs. T_2 and T_4 are the telephones. W_2 and W_4 are the trolley wheels making connection between the signal conductors and the generators.

Under the conditions shown in the diagram the train in section 2 will light its Pilot Lamp P_2, the forward green lamps S_2 and S_3 and the rear red lamps D_2 and D_3. The preceding train in section 4 will light its Pilot Lamp P_4 and the forward green lamps S_4 and S_5 and the rear red lamps D_4 and D_3.

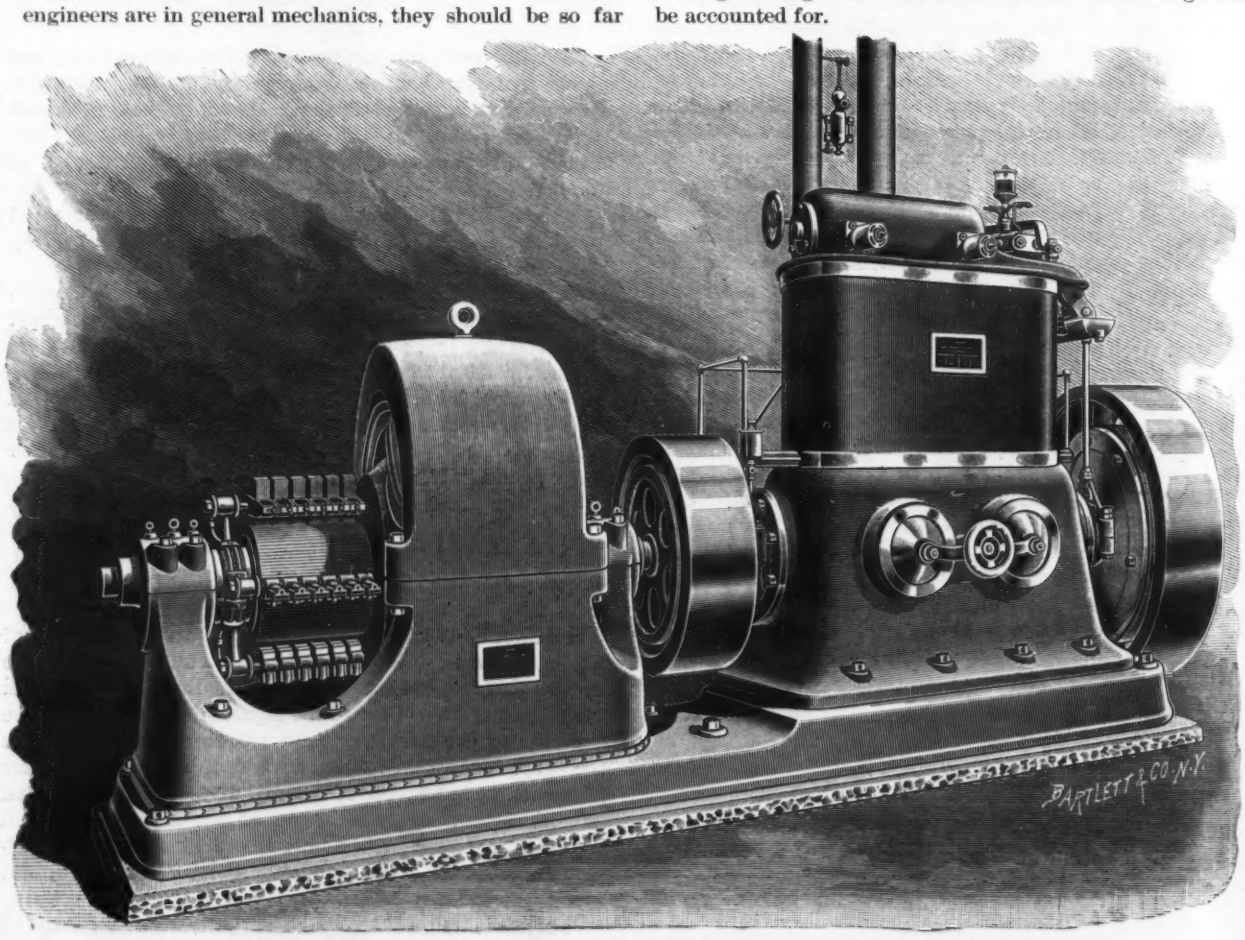
H. WARD LEONARD'S BLOCK SIGNAL SYSTEM.

Direct Coupled Generator and Westinghouse Engine.

It is somewhat remarkable that advanced as American engineers are in general mechanics, they should be so far behind European engineers in the matter of heavy construction in power stations. It is doubtful, however, if the responsibility really rests at the door of the engineering profession. The assignable cause is probably commercial. Large and relatively slow speed generators coupled to vertical compound engines of several hundred horse power is the general European practice. But European capital, contenting itself with smaller and slower returns, is willing to make the disproportionate investment required by the comparatively slow speeds which are alone possible to the forms of construction there adopted. In this country we must have faster running machinery, more compact in form and of a greater earning capacity per dollar of cost. When we add to this the further imperative requirement of safety, economy of maintenance and operation, and economy of fuel under fluctuating loads, we have erected a problem which can be permanently and successfully solved only by compound or triple-expansion engines of special designs, having in view a terminal pressure of exhaust which shall not fall below the atmosphere, even under light loads. Such an engine would come under the high-speed class, while the dynamo would in its class be distinctly low speed. The original idea attempted in various shapes of forcing an engine to an abnormal speed to meet the supposed necessities of the dynamo, was unnatural and wrong. The present state of electric art now permits the reasonable practice of cutting down the speed of the dynamo to the normal requirements of the engine.

The advantages are sufficiently apparent. The first cost of a plant on this principle, as compared with a system involving counter-shafting, clutch pulleys, belt-tighteners, belts, etc., would be enormously in its favor. This is obvious when referring to the machinery alone, but is strongly emphasized when the further value of the reduced cost of real estate and buildings is considered.

Every transformation or transmission of energy is a loss of money, and it follows that when the crank shaft of the engine is the armature shaft of the dynamo, the loss is reduced to its lowest terms. Consider for a moment that the normal resistance of an armature is strictly torsional, and the difference will be quickly appreciated between the power required to drive it when spinning it by the end against that required to drive it under the transverse strain of a heavy belt. Under ordinary conditions the belt strain to transmit 200 h. p. will be about 1,500 pounds, and the friction due to this strain is twice repeated, once on the shaft of the engine and once on the shaft of the dynamo. This is the simple case of an engine belting direct to the dynamo. Where counter-shafting is employed the frictional loss is again doubled by being repeated at the receiving and delivering bearings of the counter-shafting. The work required to overcome this friction is a net loss, and can never fall below the minimum above described, when everything is in line. If the engine shaft, or still worse, the counter-shaft, is out of line, the friction load may run up to any figure, limited only by the preservation of the bearings. With the direct connected dynamo the frictional load due to these causes entirely disappears, leaving nothing but the internal friction of the engine to be accounted for.



COMBINED WESTINGHOUSE RAILWAY GENERATOR AND ENGINE.

Next to the direct saving in power comes the saving in space. As a general statement, fully twice as much generating capacity, with the same accessibility and convenience, can be got into a given floor space with the coupled dynamo as with the direct belted generator, and from four to eight times as much as with indirect belting through counter shafting. This tells immediately upon the cost of real estate and buildings, and the accompanying items of taxes, insurance and interest.

In the item of attendance and maintenance, the coupled generator possesses manifest advantages in eliminating the

belt account wholly, and the oil and babbitt account in large part.

Most operators will gladly welcome the absence of the noise which is inseparable from the use of belting. This becomes an important and oft-times a controlling condition in stations centrally located in business and residence districts. Not the least of the recommendations of the coupled generator is that it is strictly noiseless.

Recognizing the demand for this form of generator and the likelihood of its permanent success, Messrs. Westinghouse, Church, Kerr & Co. have, in connection with the Westinghouse Electric & Manufacturing Co., developed it in the form as indicated in the engraving, and are now placing it on the market as a thoroughly practical self-contained machine. The engraving represents a 250-h. p.

POWER STATION AND CAR BARN OF THE CONCORD STREET RAILWAY COMPANY.

generator for railway work coupled to a compound engine capable of developing 250 h. p. on 100 pounds of steam, non-condensing, the speed being 250 revolutions. The design is that of a singlemachine carried upon a massive bed-plate requiring only a moderate foundation. The generator is thoroughly insulated from the bed-plate by a sheeting of tarred plank, the bolts being insulated by bushings and washers of non-conducting material. The insulation is completed at the coupling, in which non-conducting material is interposed to prevent the possibility of metallic contact. The electrician will recognize the value of this protection. The coupling is further so designed that it will yield fully to any misalignment of the two shafts either as to angle or position of centres. The larger engines are provided with unhooking gear in the valve motion so that they can be handled by a starting-bar, and are also fitted with a gallery sole-plate and stairway protected by hand rails, so that the throttle-valve and lubricator are conveniently accessible.

The same general design is carried out for direct coupling to heavy alternating dynamos. The sizes at present manufactured correspond to 125, 250 and 500 h. p., with 1,000 h. p. to follow. The sizes of engines required for the given power will vary according to the steam pressure carried, 180 pounds being contemplated as a maximum and 100 pounds as a minimum.

The same concern has also completed the preliminary work of a design for a third high-pressure cylinder for converting the compound engine into triple expansion.

The Concord (N. H.) Street Railway.

This road was formerly called the Concord Horse Railroad—the name being changed to the Concord Street Railway at the last session of the Legislature—and is one of the few narrow (3 feet) gauge electric railways in successful operation. The road is seven and one-half miles long, running from the South End at Concord to Penacook, passing through West Concord, where the power and car houses are located. The road is in excellent physical condition and is carrying a large number of passengers daily, and has demonstrated the fact that it can easily take care of large crowds if necessary, as it has frequently been called upon to do within the past few weeks.

For putting the road in this condition and placing it on a paying basis too much credit cannot be given Mr. George W. Peirce, superintendent, through whose energy and exertion the road has reached this gratifying stage.

The rolling stock consists of eight motor cars and five trailers, mostly made by the John Stephenson Co., with some modifications suggested by Superintendent Peirce to conform to the requirements of the narrow gauge. The cars are painted light blue bodies with gold lettering and present a very neat and tasty appearance.

The power is furnished by a 250 h. p. Rollins automatic cut-off engine of the Corliss type, built by the Rollins Engine Company, Nashua, N. H., and sold by Mr. J. E. Wilson, their energetic agent, 8 Oliver street, Boston, and certainly reflects great credit on builders and agent. This engine, which we illustrate herewith, is giving the best of satisfaction, governing down to five volts and less, showing its perfect adaptability for the severe duties of street railway service. There are two return tubular boilers of 125 h. p. each, and there is a good prospect that there will be another Rollins engine of 250 h. p. added to the power to replace a 125 h. p. engine held in reserve at present. As the railway company is beginning to furnish power for motors about the city, at no distant day this step will be made imperative.

At present the two engines may be connected at any time necessary by a Hill friction clutch.

Two 80 h. p. Thomson-Houston generators, type D 62, furnish the current. The belting used is made by the Page Belting Company and is all that can be desired. A fifteen minute service is maintained with a uniform fare of five cents. An extension of one and one-half miles of additional track is now under construction in what is called the "West End" of the city, which when completed will give the road nine miles of track and will make as complete a plant as can be found in any city of its size in the country.

Notes on Electrical Work in Mines.*

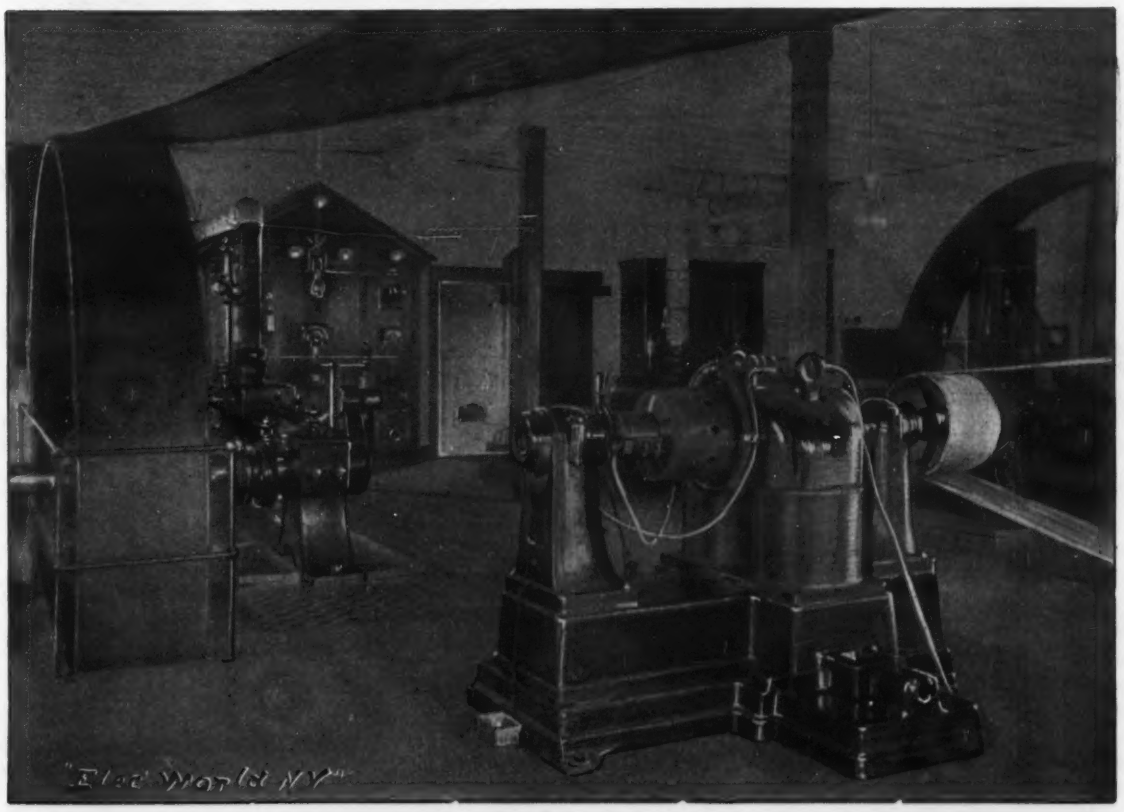
BY ALBION T. SNELL.

Another interesting application of the compound parallel system is the installation at Andrew's House pit, Durham. By the courtesy of Mr. Cuthbert Perkley I am able to give the following details: The plant comprises a dynamo, three motors, cables and three dip pumps. The pumps are respectively 1,500, 1,800 and 2,000 yards in bye; the one nearest the shaft is driven by a 4 h. p. motor, the others each work by motors of 2 h. p. The dynamo gives 250 volts and 40 ampères. The total capacity of the plant is thus small, but it is interesting on account of the distance between the pumps and the length of the cable. A few lamps are run at each of the pump stations and also in the engine-house. The dynamo is arranged to compound for constant potential at about 1,500 yards in bye. But owing to the length of cable the pressure is not maintained so uniformly as at Newbridge Rhondda installation. Each of these motors has replaced a crank which required 12 horses to keep it running through the 24 hours. The plant has now been at work for nearly two years. I may mention, in passing, that a wire rope is used for the return, and no difficulty has been experienced from this; but if the pressure were higher, or the work larger, I should advise an insulated return.

In Bohemia my company erected last year two plants of some importance in the history of mining in that district, they being the first application of electricity to mining work there. The first is at the Standard Tin Company's St. Mauritius mine. The dynamo is placed below ground, and is driven by a turbine, the water being led down a shaft by suitable pipes. The motor is arranged to work a pair of lift pumps with spears 40 metres long, and also to wind ore through the same vertical distance. When the installation was first made the lower levels were drowned out and the electric plant had to pump them dry before work could be resumed. This was successfully accomplished in a shorter time than the engineers expected, and ore is now being regularly raised by the plant. The power of the motor is about 20 horse. The second instance is at Eger, at one of the brown coal mines; here the main ventilation is produced by a fan driven by electricity, and it is, I believe, the only mine where this is the case. The dynamo is driven by a turbine about half a mile away from the fan house, and the current is carried by bare wires mounted on poles with fluid insulators. The power of the motor is approximately 25 horse. The fan has now been running for about 12 months, and the manager reports that it is working perfectly satisfactory.

We are now building a very interesting plant which illustrates the conversion of water power into electrical energy and its utilization for light and power. One thousand yards from the Greenside lead mines, near Ullswater, there is a waterfall of upward of 100 h. p. A turbine running at 1,000 revolutions per minute is coupled by a belt to one of our 100 e. h. p. four-pole transmission dynamos, wound in compound to give 625 volts and about 900 ampères. The energy is transmitted by a bare cable (19-15 S. W. G.) carried on poles to the mine mouth, and there lead-covered cables are used to convey the electricity to the various motors. These will at once run a winding plant of 10 b. h. p., a pumping plant of 10 b. h. p., and another winding plant of 20 b. h. p. is under consideration. Electric light will be used at different points of the line, and other motors will soon be installed for various purposes. Other examples might be given, but the preceding cases are fairly representative of the work now being done.

Every system of transmitting energy must necessarily entail certain risks peculiar to itself; therefore it is not surprising that we find such difficulties in connection with the use of electricity in mines. There is no doubt that the limits of these difficulties are very imperfectly understood by many mining engineers, and a few remarks on the subject may not be uninteresting. There are two distinct difficulties to contend with which may or may not be dangerous. The first is the risk from shocks. These may be received from any part of the circuit, if the installation be faulty, and under any circumstances from the brushes, commutator, and terminals of the dynamo and motors. The danger to be apprehended from electricity on this account depends primarily on the pressure of the circuit. Opinions are very much divided as to the number of volts



INTERIOR OF CONCORD STREET RAILWAY POWER STATION.

*Paper taken as read at the annual meeting of the South Wales Institute of Engineers, July 27, 1891. Continued from THE ELECTRICAL WORLD of Sept. 12, 1891.

necessary to cause death; but as, owing to difficulties of installation, the pressure in mines is usually limited to 500 volts or thereabouts, there is no fear of a fatal accident under any ordinary conditions. I have installed many plants of about this pressure, and have never heard of a single injury occurring to either the attendants or the miners, although shocks have necessarily been frequent. At St. John's colliery, Normanton, we have been working for rather more than three years with a maximum pressure of 700 volts, without a single accident happening from this cause; and further, no casualty from electrical shock in any other mine in England has to my knowledge been heard of; consequently, I venture to think that this danger is practically negligible. The second difficulty which confronts us is the risk from fire, which may occur in two ways: by sparking at the commutator gas may be fired; or through a faulty connection or a bad leak some part of the circuit may become heated and may set fire to timber. These dangers have frequently been discussed, but as a matter of fact no serious accident has occurred from the use of electricity, and should ordinary precautions be taken, and the plant be supplied and erected by a responsible firm, the chance of trouble on this score is extremely slight. Let us first look at the risks that belong to the cables themselves. It has been rightly surmised that in the event of a heavy fall of the roof breaking them, there may be a spark if ordinary single cables are used, but this danger may be minimized by using concentric cables; for if such a cable be broken by a fall, the mains will be short-circuited and the cut-out on the surface will fuse, thus cutting off the supply of electricity. In most cases, however, the cable is torn from its supports and simply buried beneath the stones, the strength of the conductor being greater than that of the supports. I have known several cases of this sort, and the cables continued in use until the fall was removed, after which, being little the worse, they were re-erected. Even assuming that the cables should break, it by no means follows that the spark, if any, would be intense enough to fire gas, nor that gas would be there in sufficient quantities to be dangerous.

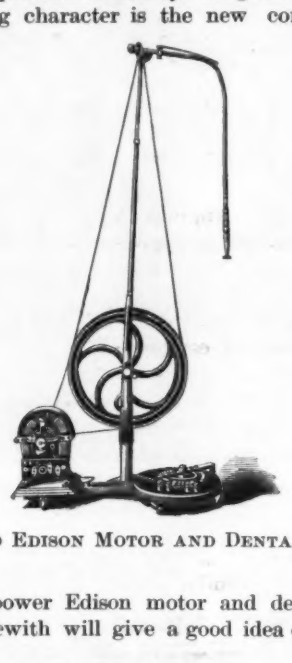
The sparking at the brushes and commutator introduces a question of a different character altogether. Although in theory a well designed motor with commutator and brushes in good order is sparkless, certainly so far as not to fire gas, yet in practice, owing to wear and tear and possibly want of attention, all motors may at times spark badly. Then arises the question, will those sparks ignite gas? In 1888, when speaking on this subject before the Midland Mining Institute, I gave it as my opinion that the sparks at the brushes of a motor would not readily fire gas on account of their low temperature. This low temperature is due to the large mass of metal in contact with them. To make this point clear I made the following experiment: In a wooden box about six feet long with an internal cross section of a square foot, I put a small motor and a gas gauge; a glass window was arranged in the centre of the box, so that the gauge could be read and the sparking noted. One end of the box was closed and the other fitted with a hinged door. Ordinary coal gas was then admitted at the closed end, and the motor started. The mixture of air and gas in the box was varied through the most explosive ranges and the motor ran for half an hour without firing the gas, although the brushes were sparking more than normally. These were then shifted so as to cause excessive sparking, thus heating both brushes and commutator, the heat at the points of the former being so great that oxide of copper was formed and deposited on them in a white film. At this point the gas exploded. Marsh gas and air explode at about 1,000° C. (1,832° F.) according to the mixture. It would appear to follow that although under normal conditions there would be little danger of a motor igniting gas, yet, if by any means the brushes and commutator became heated beyond a certain intermediate point, this danger would arise; and if motors are to be used in fiery mines it will be necessary to protect them.

Two ways of doing this suggest themselves. The one is to enclose the entire armature and commutator in a dust-tight metal box sufficiently strong to resist the force of the explosion of possible gas within it; and the other is to box in the commutator and brushes only. The former method has the advantage of also guarding against sparks caused by a possible short circuit on the armature. The second method does not protect the armature winding at all, but it reduces to a minimum the volume of gas which may be exploded by sparks. Both methods are good in their way, and, by proper attention to details, I believe that with either the risks will be comparatively slight. Of course, the best protection is ample ventilation, for if the faces are swept with plenty of fresh air, and the roof properly packed and looked after, there can be no danger from the cause in question. The protection of the motor should only be expected to act as a safeguard against "blowers," because under ordinary mining regulations men would not be allowed to work in a fiery atmosphere. If the motor be fixed at a pump or hauling engine, the difficulties are materially lessened, for the air would not be foul in such places, and if the "blower" worked against the main air-way there would be ample time for the men to switch off the motor before withdrawing, or it could be stopped from the surface.

Combined Dental Drill and Motor.

That the practical applications of electricity to useful service are as limitless as electricity itself, is evident from the new developments constantly being made.

Of a striking character is the new combination one-



COMBINED EDISON MOTOR AND DENTAL ENGINE.

twelfth horse-power Edison motor and dental drill. The cut shown herewith will give a good idea of the arrangement.

An ordinary dental drill is used, the foot lever and crank being removed. The old pivot is utilized to fix a strip of steel upon which can slide the one-twelfth horse-power Edison motor, arrangement being made to clamp it in any position, so that the belt which is placed around the fly wheel and pulley of the motor can be kept at any desired tension. The motor, therefore, occupies one of the legs, and the other two legs are used to support the reversing and resistance switch. The handle of the switch is of a special construction so that the operator can use it as readily as the treadle. It is arranged to project over the edge of the resistance coil, and the operator can, by a slight movement of his foot, switch it over to either side, so that the motor runs in either direction at will.

If the arm is in the central position the current is "off." If between the central position and one side, the motor runs in one direction, but not at "full" speed.

Catch clips are arranged so that the operator can tell immediately he has reached either the "off" position or the "full on" position on either side. He can also obtain four different speeds below full speed. The motor is designed to run on a 125-volt circuit, so that it can be used on a local electric light circuit. A wall socket is fixed near the dental chair and a flexible cord led from this to two terminals on the motor.

Motors wound to be operated by a battery have been perfected, so that this ingenious device is placed within the reach of the entire dental profession. Storage batteries can be employed whenever current for charging can be obtained, even if direct circuits are unavailable, and the motors can be obtained for any voltage to suit the source of supply that may be most available in any particular location where a power dental drill is required.

Good and Bad Leclanche Batteries.

The Leclanché battery has found its way into very extended use and there has been such keen competition in its manufacture that there might well be some little wonder if poor types did not occasionally appear. Some interesting comment on this fact comes to us from Mr. C. J. Hirlimann, who was one of the pioneers in bringing to public notice in this country the original Leclanché cell. Mr. Hirlimann says that this type of battery has suffered of late years very seriously from the result of attempts to cheapen manufacture. Two cells apparently the same may be found to differ to a very considerable extent in performance, due to the fact that while the makers of the one took care to use good material in the preparation of the depolarizing mixture which surrounds the carbon plate, others from a desire to save a few cents would turn out a battery that would give most unsatisfactory results. Every time five cents' worth of material is skimped in the manufacture of the depolarizer $50 per thousand is saved in the manufacture, a sum sufficient to yield a handsome profit to the manufacturer, but the cell is thereby rendered much inferior by a relatively very large amount. Mr. Hirlimann says he firmly believes that if the same sort of false economy could be applied elsewhere in the cell without detection that some makers would make the zinc hollow, or the porous cup out of mud. If in the use of the batteries of to-day we do not find instances of cells used that have done good work for from two to six years, it is simply because there has been false economy at the one point in the battery where it cannot be readily detected, that is in the depolarizing material. A cent or two saved here means a serious loss of public confidence in what is really a most useful battery, and the most conservative makers would keep up the standard even if they were compelled to charge a few cents more for a really durable cell.

The Latest Short Motors.

About six months ago the Short gearless street railway motor was announced, and we have been awaiting with interest ever since detailed news of its performance. There was every reason to believe that under favorable conditions at least it would be satisfactory, and news received from Cleveland shows that this expectation is fulfilled, although we are sorry to say that as yet no roads have been fully equipped with this motor, so that a careful study of its performance under various conditions is still lacking. The result of a year of investigation and experiment on gearless motors by the Short Company went to show that a working gearless motor would be unlikely to prove successful unless it was of multipolar construction with very powerful magnetic circuit and small magnetic gap equipped with a Gramme armature of comparatively large diameter. These characteristics were embodied in the present gearless motor, which in its latest form is well shown in Fig. 1. There are but three wearing points on each motor and the armature of the ordinary Short type is of extra large diameter and is supported, as we have heretofore more than once explained, on a hollow shaft concentric with the axle but with sufficient clearance to enable the motor to be flexibly supported. The field magnets, eight in number, are arranged something as in the Brush dynamo and are belted to the frame work of the motor, in the centre of which are the bearings which carry the hollow armature shaft. A glance at the cut will show the method of mounting the machine. A three-armed spider is placed on each bed of the hollow shaft, each arm is provided at the extremity with a socket to receive the rubber cushion or spring, these cushions bear upon lugs cast on the car wheels, and as the armature shaft and spider revolve the action is transferred to the car axle. The rubber cushion serves the double purpose of insulation and easy starting and has replaced the metallic spiral springs of the earlier forms of the motor. The insulation from the truck is very complete and the results have proved to be excellent, as in all three types of Short motor accidental leakage and short circuits on the frame have been practically avoided. As regards dimensions and speed, the distance from the centre of the axle to the bottom of the casting is 12¾ inches, and at a speed of 12 miles per hour with 36-inch wheel the armature revolves at 94 turns per minute. The electrical output of the motor has been

THE NEW SHORT GEARLESS AND SINGLE REDUCTION GEAR MOTORS.

quite carefully investigated, and as an average of a large number of readings taken on the three electric lines in Cleveland the following results have been obtained: Average volts 480, average ampères 24, electrical horse power 15.44, average number of passengers 48. In addition to the gearless motor the Short company, aside from their standard machine that is now familiar to most of our readers, has placed upon the market a single reduction gear motor known as the water-tight, and more familiarly as the W. T. One pinion and one gear have been dispensed with and the remaining gear is run in oil. Fig. 2 gives an excellent idea of the arrangement of this machine. It is of about the same efficiency as the other types, but is claimed to be the lightest and smallest of the standard street car motors thus far built. It weighs all told a trifle less than 1,800 pounds, is encased and completely protected by its iron frame and can be operated on 30, 33 or 36 inch wheels, and any gauge of track down to three feet. It is especially recommended for narrow gauge roads, for mining and similar purposes. Two sizes of this W. T. motor are made, 15 and 20 h. p. The use of a large Gramme armature and the simplicity of the working parts have shown direct results in an unusually small repair bill. One of the very useful features of both these Short motors is the facility with which repairing, in cases of necessity, can be carried on; by loosening four bolts in the motor frame and taking off the iron strips below the wheel boxes a car equipped with gearless motors may be jacked up and axle, wheels and armature complete run out from under the car. The armature coils may be rewound without removing the armature from the axle, and the field coils can be quite as easily repaired. The commutator may be reached and cared for with entire ease while the machine is running. With the geared motors it is not necessary to remove the motor and car wheels; the car can be run over a pit and every part of the motor reached without difficulty. The motor field coils and armature are entirely easy of access, and the armature can be removed in case of necessity by two men in eight minutes, its weight being only 198 pounds. In fact, every part of the motor can be removed without taking the machine to pieces. On the Rochester, N. Y., railway during eight months of operation the total cost of repairs, including material and repairs to electrical machinery, was but four mills per car mile, and the average loss per car from necessary repairs was but four per cent. of the total car mileage. These results are eminently satisfactory and highly creditable to the Short company.

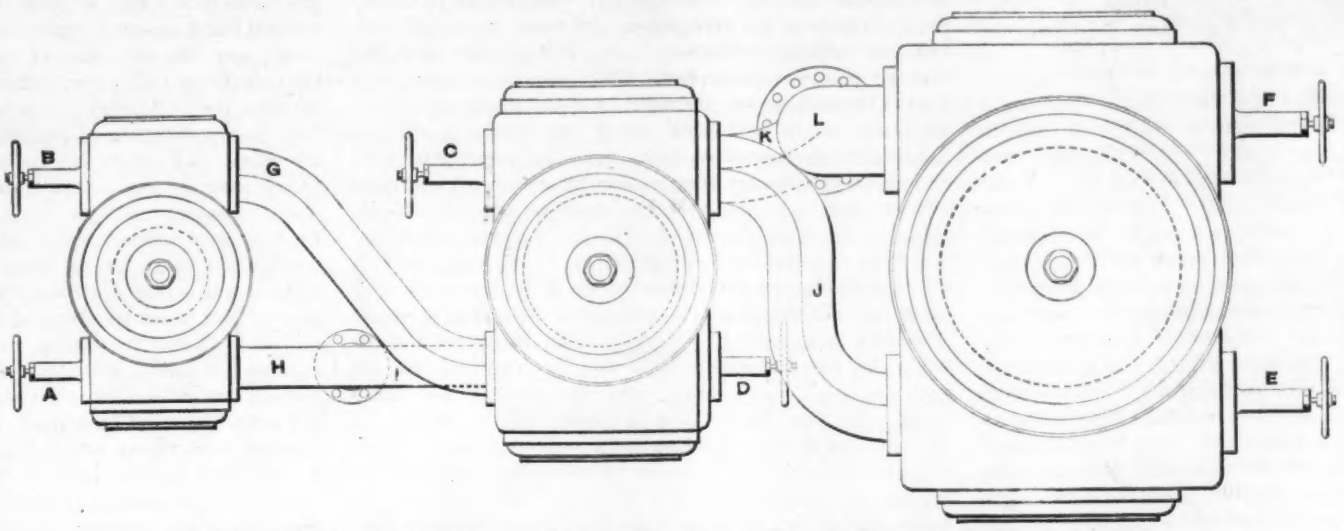


FIG. 1.—TRIPLE EXPANSION ENGINE OF THE LAKE ERIE ENGINEERING WORKS.

The Recent Engine Designed by the Lake Erie Engineering Works, Buffalo, N. Y.

These engines are designed in view of meeting the continually increasing demand for economy in floor space, in the use of steam, and thorough reliability. They are especially adapted for central station electric lighting and railway work, giving the closest regulation and best economy, and occupying a very small portion of the floor space heretofore occupied by economical engines, and are really the first practical solution of the problem of direct connection, or direct belting, for the larger types of generators now being introduced in the country.

The rotative speed is chosen somewhat above the limitations imposed by the releasing valve gear of other engines, but it is not what is called high speed. The engines occupy a middle ground in this particular. The pressures per square inch on the bearings and the rubbing velocities of the journals form the starting point in establishing the rotative speed, the rate of rotation varying in the different sizes of engines inversely proportional to the diameters of their shafts, and the pressure per inch of bearing surface is kept below a certain limitation in all sizes. This insures uniform results.

The piston speed is universally 650 feet per minute, and the stroke is reckoned from the diameter of the shaft and its consequent rate of rotation.

The accompanying illustration is from scale drawings of triple expansion engines shown connected directly to two 500-h. p. generators, and intended to work under from 140 pounds to 160 pounds steam pressure when connected with condensers, and from 180 pounds to 200 pounds steam when exhausting into the atmosphere.

Their rated power is 1,000 horse when most economically loaded, but they are capable of performing 1,200 h. p. or more very easily should they be called on to do so. It is expected to obtain as good economy with these engines working under from 130 pounds to 200 pounds steam pressure, without condensers, as with best compound condensing engines under from 30 to 100 pounds steam. Their adaptability, therefore, to situations where water cannot be obtained for condensation, is apparent. It is safe to say that by using triple expansion engines thoroughly adapted to the service under heavy steam pressure without condensers, not more than one-half the fuel now commonly used will be required.

Add to this the limited floor space for these machines, and the large saving of real estate in this particular, and the importance of this advanced step in engineering becomes conspicuous; 1,000 h. p. triple expansion, including electric generators and all, will occupy the limited space on the floor of 14 × 24 feet, and without the least inconvenience in getting access to all working parts, and without embodying an element which is not in accordance with the most advanced usage in modern engineering.

Fig. 2 is a front view of the three cylinder type. In this design each cylinder acts on an independent set of cranks on a common crank shaft; this is 9¾ inches diameter and carries at each end an armature, and having two intermediate wheels. In this manner the weight is distributed evenly along the shaft upon bearings, tending to equal wear upon each journal and in this manner keeping the shaft straight and free from undue strains.

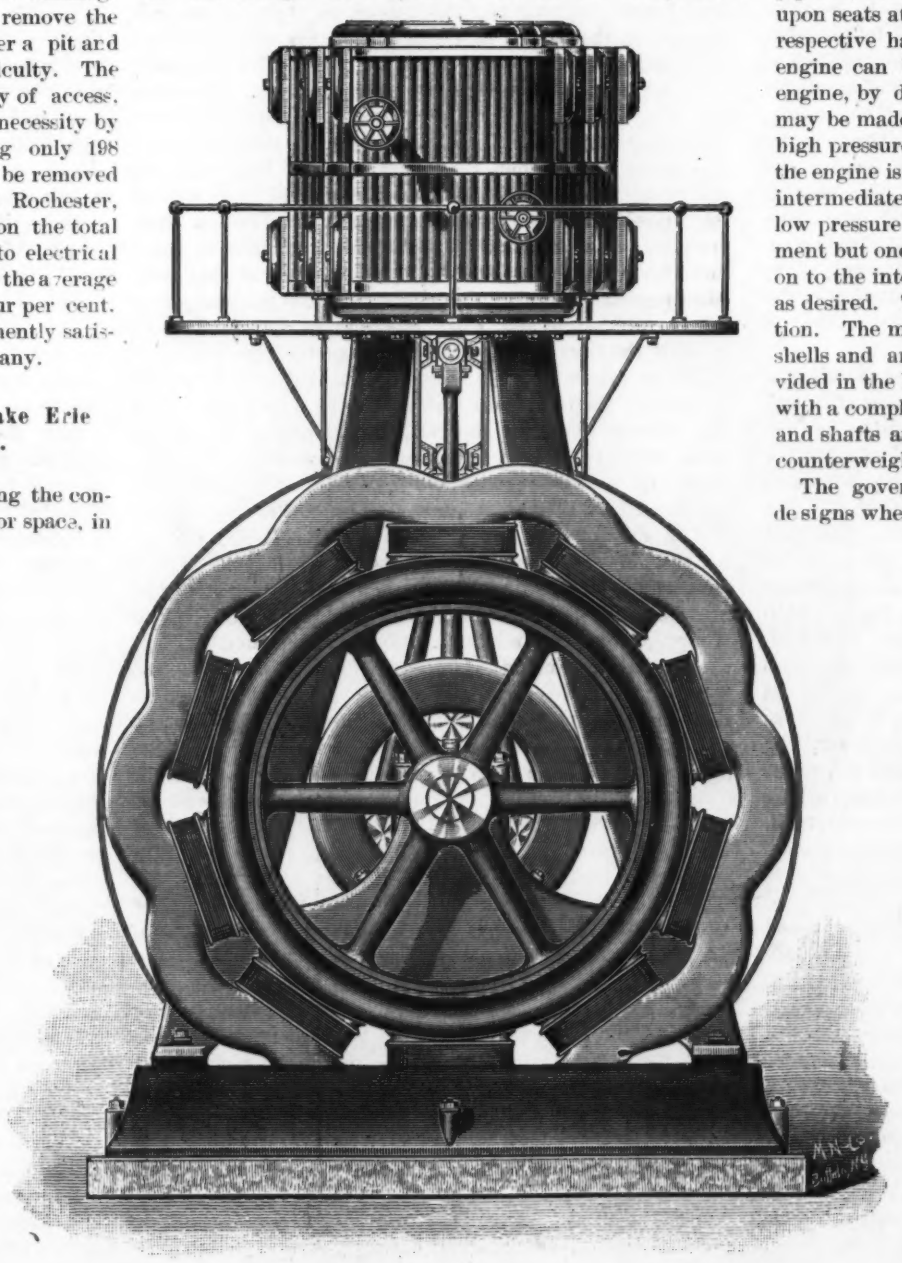


FIG. 2.—TRIPLE EXPANSION ENGINE OF THE LAKE ERIE ENGINEERING WORKS.

Each cylinder has an independent framing and pedestal, the whole including the generators, standing on a common bed plate.

The columns are "divided," allowing sufficient space between the divided halves for the valve stems and rock arms of the high pressure and intermediate pressure cylinders, bringing the valve chests at right angles to the crank shaft where they are perfectly easy of access. These valve chests form the receivers between the cylinders. Four valves are used on each cylinder, the steam and exhaust being independent of each other and the steam lap and exhaust lap adjustable, so the admission, lead, closing and opening of exhaust, or point of cut-off may be easily altered by adjustment. In this manner the engine is easily adapted to any service either condensing or non-condensing. In addition to this the point of cut-off may be changed by hand for the low-pressure cylinders while running, so as to afford that refinement in the management of the receiver pressures required for exceptional economy in the use of steam.

The clearances are small, averaging from 2½ to 6 per cent. according to the sizes of cylinders, and the valves are adjusted to fill the clearance by compression, neutralizing the small loss that would occur in those limited clearance spaces and at the same time insuring against "knocking" on the road bearings and main journals.

The valves are four-ported, therefore small and light, flattened and nearly balanced, pressing against their seats just sufficiently to keep tight, and are allowed to follow their wear. The engines are of the disconnective type.

By referring to Fig. 1 it is seen that the hand wheels *A*, *B*, *C*, *D*, *F* and *E*, are placed on the steam chest opposite the pipes *H*, *G*, *K*, *I*, *J* and *L* respectively, the valves being placed upon seats at the ends of the pipes and operated by their respective hand wheels. By the use of these valves the engine can be converted into either a small compound engine, by disconnecting the low pressure cylinder, or it may be made into a large compound by disconnecting the high pressure cylinder, and the change can be made while the engine is running, the governor being connected to the intermediate steam valves when using the intermediate and low pressure cylinders as a compound. By this arrangement but one governor is used and its action can be thrown on to the intermediate steam valves either in full or in part as desired. This gear will be a subject for future illustration. The main bearings are provided with babbitt lined shells and are water-jacketed, a water-jacket being provided in the back of guides also. The engines are equipped with a complete system for grease lubrication. The cranks and shafts are forged and of the built up pattern with counterweighted crank arms.

The governor for this engine is such as is used in designs where there is liberty to place it at the end of the shaft, the valves being driven from an outside pin as shown. A similar governor is placed in one of the intermediate wheels in the triple engine shown herewith. The Lake Erie Engineering Works are equipped to build these engines in sizes from 150 h. p. to 10,000 h. p.

The principal dimensions are as follows:

Diameter of high pressure cylinder	16 in.
" " intermediate "	26 "
" " low pressure "	40 "
Stroke	34 "
Diameter of shaft	9¾ "
Height above cap stone	21 ft. 9 in.
Length over generators	23 " 6 "
Breadth	14 "
Revolutions per minute	115

Another design shows the engine arranged as a four cylinder triple. By putting it in this form some floor space is saved over the three-cylinder type and the economy is about the same. The engine is disconnected and automatically regulated. Putting its bearings at equal service with the three-cylinder engines, its speed is 94 revolutions per minute. The principal dimensions are as follows:

Height above capstone	29 ft. 6 in.
" " first landing	24 " 6 "
Length over generators	19 " 10 "
Breadth	13 " 3 "
Diameter high pressure cylinder	16 "
" intermediate "	26 "
" low pressure "	28 "
" shaft	11¾ "
Stroke	41 "

These engines are designed in view of occupying the very least floor space consistent with thoroughly successful construction. In either design, belt wheels may be substituted in place of generators at the ends of the shaft.

The Field Engineering Company, of New York, who are making a specialty of large power station construction and

have built a number of representative stations for railway and lighting work, and who have been looking for an engine which would best fill the requirements of their practice, have concluded arrangements to especially represent this engine in their line of work, and they are having the Lake Erie Engineering Works build two large engines of this type in two cylinder compound, soon to be installed in the power station of the Buffalo Railway Company.

Discussion of Prof. Harris J. Ryan's Paper on Armature Reactions Before the American Institute of Electrical Engineers.

Mr. C. O. Mailloux: I do not feel that I understand the paper sufficiently to be able to discuss it intelligently. It contains much matter which requires very careful analysis and digestion to enable it to be discussed properly and intelligently. There are probably some statements to which we might take exception. I think it would be a very much better and more profitable discussion if we had a chance to study the paper, and if Prof. Ryan himself were here to answer questions when the paper is discussed. The whole subject of armature reactions is among the most difficult and puzzling in electrical engineering. There can scarcely be a more perplexing problem, because we have to deal here with the phenomenon of "action at a distance," which has engaged and baffled the efforts of all the great scientific thinkers of the world since the days when Newton pondered over it and made some steps toward a theory which he applied to actions at a distance among the heavenly bodies. During the last few years there has been a great deal written on what might be called the "physics of the air gap" though I believe that the true physical theory of the air gap has yet to be written. Even with all the theory which we have, and while paying proper deference and respect to the very able work of such men as Hopkinson, Swinburne, Esson and others—I cannot believe that we have, after all, much more than working hypotheses; that we have, so to speak, only provisional theories, which are good so far only as they cover the facts now known to us. The truth is, we do not yet know all the facts pertaining to the physics of the air gap, and it will probably be some time before we understand them all. Though I will not undertake the discussion of this paper, I would refer to one point in connection with what is said: "When the armature ampère turns are equal to the ampère turns on the field, whose magnetizing force is impressed between its pole faces through the armature." It is quite evident from the sentence which immediately follows that the author wishes to imply what is sometimes spoken of and what is generally understood as difference of magnetic potential. Mr. Swinburne, I believe, has given it that name, and as we have the exact analogue of it in relation to the electric circuit, I see no reason why we could not use the term in relation to the magnetic circuit, and thus express the author's meaning at least as clearly and more succinctly. It is mathematically the line integral of magneto-motive force for that part of the circuit. It means, so to speak, the magneto-motive force lost in the air gap; the whole magneto-motive force minus the portion that is lost in the field reluctance itself.

The much mooted question as to the length of the air gap and its relation to the phenomenon of sparking of course forms one of the principal subjects that the author has discussed. I have given that subject a great deal of attention in my professional work, and I have taken great care to scan and to canvass the literature on the subject. I find that there is considerable divergence of opinion, and that while theorists are telling us that we should not make the air gap too small and that we must have a certain minimum of resistance there, yet machines are being made which are very successful, not to say most successful, in which the air gap is exceedingly small. The Oerlikon dynamo works in Switzerland, perhaps one of the most successful firms building dynamos in the world to-day, is noted for the extremely small air gap used in its dynamos, the amature iron being perforated near the edge and the wires passed through the perforations near the periphery of the armature, so that the air gap may be and is very small. Mr. Ravenshaw, in England, has, I believe, cited some experiments with a given machine, which he first tried with a very small air gap; he then bored out the field and tried the experiment over again, maintaining the same magnetic density through the *entrefer*. He found, if I quote him correctly, that it did not make any practical difference so far as the limiting output of the machine, within which sparkless running occurs, was concerned. One would conclude from this that it does not make very much difference what is the length of the air gap if certain other apparently equally important factors receive due consideration in the design. Among the factors which a comprehensive theory of armature reactions should include, in my opinion, and which are somewhat neglected by the author, are the number and length of armature reactions, the width of pole pieces, the mode of winding, etc. I regret, indeed, that I have not had a chance to thoroughly analyze the paper. It certainly discusses one of the most important subjects which could be brought before this institute, because it relates to a problem of the greatest importance, and regarding which any new knowledge must be of great value to the designer of electrical machinery. It is certainly to be hoped that a good discussion will be had upon it at some future date. I think the paper is well worthy of the attention of the ablest and most competent members in our midst.

Prof. Anthony: Mr. President, I would say one or two words further in regard to this. I feel exactly as Mr. Mailloux does, that we ought to have some opportunity for a discussion of this paper after we have had some time for the study of the paper itself. There are such a multitude of details connected with the action of the armature dynamo that it will take very considerable study before we can discuss the paper very intelligently. The length of the air gap, the form of the pole pieces, the form of the pole corners, the relation of the pole cores, of the field cores, the number of ampère turns on the field cores. the winding, and I don't know how many dozen of other things will affect the action of the armature, affect the sparking, and the relation of electromotive force, whether constant or not: and all these different things must be considered and their effects taken into account. It seems to me a pretty difficult thing for any one to consider offhand. I should like to say one word in reference to the width of the air gap here. It was something of a surprise to me to have it implied, as it seems to be in this paper, that the air gap must have somewhat of a magnitude in order to make the dynamo work well. My idea has always been that we must make the air gap as small as possible, and the smaller we could make it the better the dynamo would work. I do not know that I have ever seen anything in my experience that would indicate the necessity of making the air gap any larger than was necessary for getting in the wires, and in fact in a machine that I have recently constructed we made an armature two feet in diameter for the very purpose of getting the wire in one layer and getting the air gap only one quarter of an inch, with about 100 ampères normal output. When the generator was running street cars, and the current was jumping from 0 to 200 ampères and back continually, it was almost impossible to tell by watching under the brushes when the generator was doing work. The creaking of the engine, etc., indicated it, and a man could imagine that he saw a little sparking when he heard the engine working. They were carbon brushes.

Mr. T. D. Lockwood: It may not be out of order to state that in the card which I received notifying me of this evening's meeting, the subject was mentioned with the intimation if I was particularly interested therein I could receive a copy by sending for one, but as I supposed there would be a great many here more interested in air gaps than I was (since my business relates to the very smallest dynamo in the world, in which I have always found that the smallest air gap possible was the best for the machine), I did not take the trouble to send for the paper. Perhaps, like other gentlemen, I should, therefore, plead my inability to discuss the subject on that score. I think we may reasonably regret that Prof. Ryan is not here with us this evening to answer questions. I should have wished for myself that the author of the paper had been a little more particular to classify the different machines in question, for while he speaks in a general way at first, and subsequently speaks of a constant potential machine, it is rather difficult to tell what machine he is referring to most of the time, until on the last page but one, where he comes to speak of "Mr. Esson's valuable paper, to which I referred before." He speaks there of a generator for constant current, by which I suppose he means what we call a series machine with closed coil armatures, by which regulation is achieved by adjusting the brushes. I have a very distinct idea that sparking in dynamos is largely due to a lack of harmony between the short circuited current, as an individual coil passes under a brush, and the current in that side of the multiple coil armature which the short circuited coil is approaching. And it has further appeared evident to me, that if we could produce at the moment when the front segment of the commutator leaves the brush—if at that moment we would produce a zero, by opposing the short circuited current against the current to which the short circuited coil is about to be introduced, we should have a perfect neutralization, and, in consequence, an absence of sparking. I am well aware that there has been a kind of hazy doctrine circulating, or at all events existing, among electricians that the sparking upon a change of current, and when brushes were used to compensate for that change of current, is largely due to the fact that the neutral line had moved forward, and that therefore the brushes would have to be moved forward to catch up to the neutral line, and when the brushes did catch up with the neutral line the sparking would cease to exist. But when you pursue that theory to its lair you find it is moving in a circle. It may not be out of order to recount an experiment I witnessed showing that in reality as the current in a series machine changed under a difference in load, the neutral line remained stationary as long as the brushes were not moved. For example, suppose a machine was working on a load of 40 arc lamps and some 10 of those would be cut out,—the load would be very much less, the current would be much stronger,—and in a machine furnished with an automatic regulator, the regulator would move forward to cut down the electromotive force developed, of course, in bringing the current down to its constant figure once more. It was supposed by many that the neutral line of the machine moved forward when the current changed. That is, when the current increased the neutral line moved forward. It hardly seemed to me that it was a possible thing, seeing that the current was strengthened not only in the field helices, but also in the armature, the machine being a series machine. A single wire was rigged around the armature. One end was attached to a fixed ring, while the other end was attached to a movable commutator, and the circuit of this wire included a telephone receiver. When the machine was working on a full load, we found a place where there was a zero of current. It was absolutely on the neutral line of the machine as it was working then. By the neutral line I mean the moment when a given coil passes over from the influence of the pole upon one side to the pole upon the other, when it is at the exact point between the two; that is when it ceases to cross lines of force in one direction and begins to cross them in the other direction. We found that point, and found that the telephone gave forth no sound at all upon changes of resistance and consequent changes of current. Just as long as the brushes were unmoved the telephone gave no sound, no matter how many lamps were put out or how much the current was changed, showing that the neutral line did not move. But when we changed the position of the brushes, and moved them forward to compensate for the increased current we found that there was a change, and that the neutral line did not move forward as it was supposed to do, but actually moved backward. Now that was the result of absolute experiment, and I think when we reflect upon it we will find that experiment is in accord with the best theory, and therefore I think the gap has such a relation to sparking in the constant current machine only in so far as it may modify the form of the pole pieces, and instead of using the phraseology here, I should rather be inclined to use the phraseology that "the requisite feature for a generator for constant current on closed coil armature in which regulation is effected by shifting the brushes, is that the field should be uniform throughout the range of movement of the brushes."

Mr. Nikola Tesla: I have had excellent opportunities to study the importance of the air gap, particularly in some types of my motors in which the armature coils are closed. Such a motor is of course a transformer, and following the analogy the first idea was to secure in it as good a closure of the magnetic circuit as practicable. In the early experiments I constructed motors in which the air gap was often as low as a sixty-fourth of an inch at the start, and was gradually increased. This was the result arrived at: up to a certain point the diminution of the air gap would act very favorably; then, the further approach of iron or the reduction of the air gap would begin to be a great drawback: and it has always been my idea that the real cause of that was the unsymmetrical position of the armature to the field, and the impossibility of making the motor so mechanically perfect that the pull on both sides would be equal. Sometime ago I did some work on unipolar dynamos with iron discs and I found that the lateral thrust was very difficult to overcome and it was impracticable to work with very small air gaps, a fact which, of course, is well known. In the results presented by Prof. Ryan there is a point which he has not considered, and which, if I may be permitted to say it, I think ought to have been considered, because it is of enormous importance, so important that it radically changes the whole result, and that is this: In a motor or generator, in which the polar faces and the armature core both are smooth, we can reduce the air gap indefinitely, and the smaller it is the better, and in many experiments I have found that we cannot reduce it far enough, disregarding mechanical difficulties. But directly we put projections on the field, as for instance Prof. Ryan has done (he mentions an experiment in which there were six slots across the field), we cannot work any more with a very small air gap. You see the reason plainly enough. The putting on of these air gaps brings the whole investigation on a different field. If the polar faces be smooth, no matter how close you approach the iron to iron the armature undergoes a gradual change, but directly you have the grooves, each part of the armature surface has to get out from the very intense field into a weak field, and then from the weak field into an intense field, and so on, repeatedly; six times, as in Prof. Ryan's experiments. I have made a great many experiments which confirm that. You can take a smooth field, put a laminated armature, without projections in it, and work with a certain magnetism, revolving the armature at a given speed. It will not get hot to a high degree. Now, put in grooves through the field and you will find at once that with far less magnetization than before the armature will get intensely hot. The reason is that you put each part of the armature through a much more sudden and greater total change, and increase the frictional and current losses. That is the reason also that in the case of the grooves there is a certain increased loss in the voltage attributed by Prof. Ryan wholly to a different cause.

The chairman's remarks in regard to Mr. Esson's valuable paper suggest to me a subject in another line of work which I have been pursuing. Mr. Esson pointed out certain requisites of constant current generators with closed coil armatures which practice would not seem to confirm. On this subject I think that I will not risk much in predicting that in a comparatively short time most of the present constant current machines will be replaced by machines of a more modern and improved construction. The old types of these machines have been built by ingenious men who, rather instinctively, hit upon the right thing—right

at that time, but not right now. The main object in these machines is to maintain a constant current in the most efficient and simple manner. Some time ago I had occasion to say a few words—I think in a paper—in regard to this matter. I have constructed such machines in accordance with my view, which is to produce a great rate of change in the current, and to replace the ohmic resistance required for steady working by impedance. In this manner you can construct an arc light machine with only one single layer of wire, no matter how large it is, and you can make it maintain a constant current, within two or three per cent., without any external regulator. One of the ways of obtaining this result is the following: Take, for instance, a two-pole machine, selecting a type which allows you to use an armature of the greatest possible diameter. By all means make the armature as large as possible. Then, instead of making the pole projections of the field smooth, make them with grooves parallel to the armature shaft. The more you make, in fact, the better it is up to a certain point. Then wind the armature symmetrically with reference to the pole projections or grooves, so that you get a great rate of change in the current. Now, then, you have a direct current, which is commutated just the same as in the Gramme machine, but as to the rate of change it is equivalent to a rapidly alternating current, and of course you increase the impedance through the whole circuit to the extent that you can do away with the great ohmic resistance in the circuit, and you can make the impedance and the armature reaction so great that no matter what the load is, the current is the same. Such a machine has numerous advantages, not the least of which is that it is more efficient, and then again it is so easily repaired, only one layer being required. In all alternating generators almost without exception the armatures are built with one single layer of wire. The arc light machine must also be built with single layers, and the right way to do this is to provide the pole pieces with projections and wind the machine in such a manner that a current of the requisite character is obtained. In regard to the shape of the pole pieces I had opportunity during the year 1885 to make some observations. I then worked at what is called the third brush regulation. It is a principle very interesting, but not very reliable. It may give a wonderful result for a short time, but when you want to show it to the stockholders it cannot do very much. It has been original with me. There have been some other claimants—there are always claimants. But to return to the subject—one of the difficulties encountered in the third brush regulation was the excessive sparking of the third brush. To overcome this, the principal requisite was that the auxiliary brush should not bear on active coils. I then resorted to a means which was obvious. I put under every leading pole piece a good sized groove, which made the coils on each auxiliary brush comparatively inactive, so that the auxiliary as well as the main brushes would bear upon inactive coils. In this manner I obviated the sparking, but the machine did not look particularly pleasing.

Mr. Brown: Yes, I make the motion that it be definitely announced that there will be further discussion of this paper at the next meeting or the next following, as may seem best to the chairman to-night, and that the secretary be asked to forward copies to such members as he judges are more particularly conversant with the subject, with the request that they send us letters.

Mr. Mailloux: I second the motion.

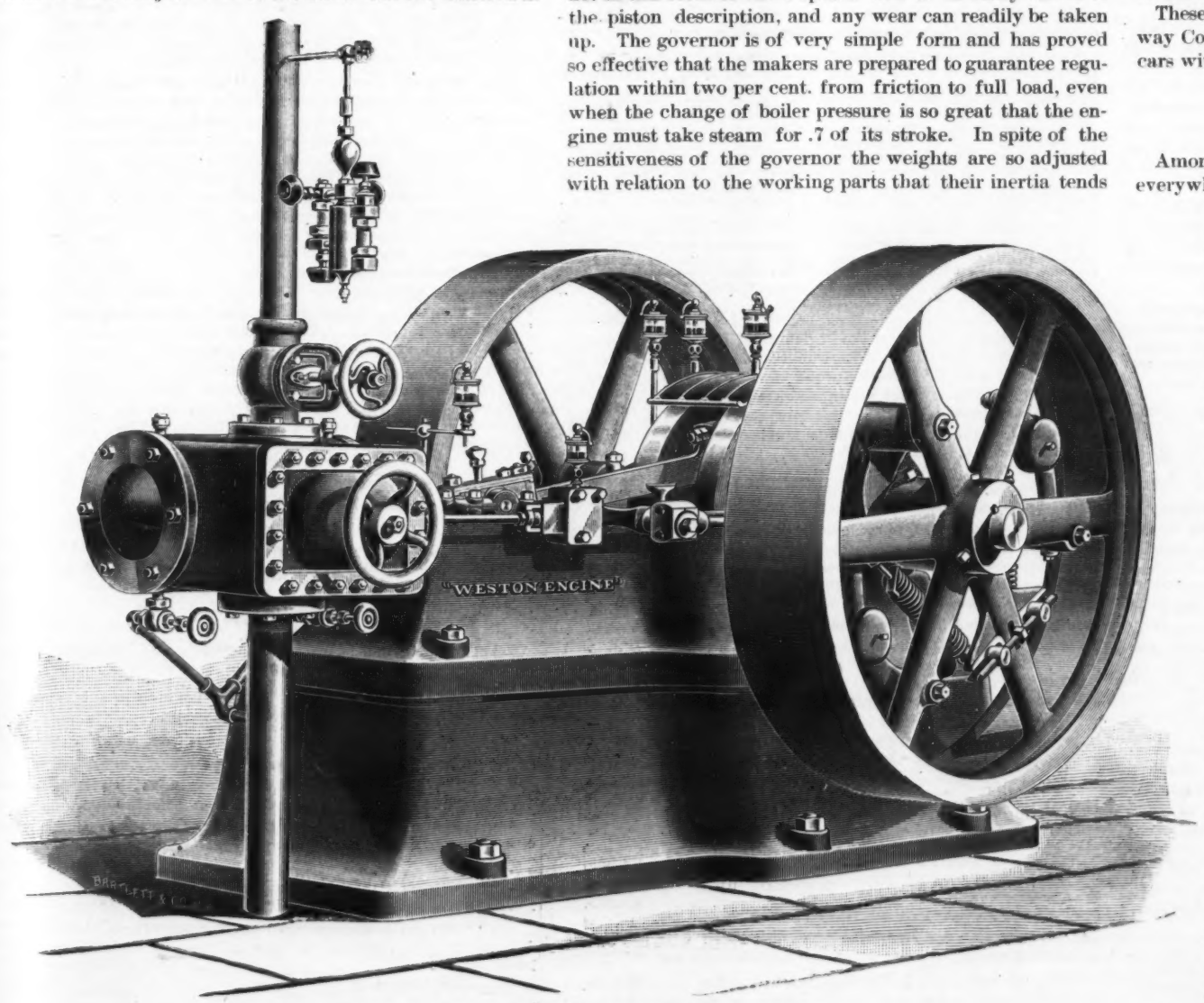
The motion was carried.

The Secretary: The report of the Committee on Units and Standards, which, as I understand from Mr. Wetzler, includes a subject brought up before the Frankfort Congress, will probably be submitted to the Institute for discussion, either at the October or the November meeting. The report was referred to the Committee on Papers and Meetings, by Council, with the request that it be brought before the institute for discussion at an early day. The next meeting will be held Oct. 20, when a paper will be read by Mr. H. Ward Leonard on "A Motor Operating Automatically at Any Desired Speed or Torque, and with Maximum Efficiency Under all Conditions."

Adjourned.

The Weston Automatic Engine.

The steady growth of central stations and isolated plants for electric lighting has caused a rapidly increasing demand for automatic high speed engines of various classes, and new ones are constantly coming upon the market and the general excellence of manufacture is now much more satisfactory than a few years ago. One of the very latest applicants for popular favor in the line of improved steam machinery is the Weston automatic engine, one type of which is illustrated herewith. The engine is very simply and strongly constructed, the body substantial and the metal is distributed with special reference toward avoiding flexure between guides, which, according to the best modern practice, are a fixed portion of the bed, planed in and scraped till the fit is perfect. The valve is a rather interesting feature of these machines; it is a modified piston valve of rectangular almost flat section, with an adjustable bearing against the pressure plate, so that the valve may lift to relieve the cylinder of water just as if it were an ordinary slide valve. It gives four openings for the admission of steam, each equal in length to the diameter of the cylinder; this feature, together with a large valve travel and wide ports gives, as would be expected, a high steam line on a clean sharp cut-off. Wearing down by its own weight does not in this form of valve open a leak as in many valves of the piston description, and any wear can readily be taken up. The governor is of very simple form and has proved so effective that the makers are prepared to guarantee regulation within two per cent. from friction to full load, even when the change of boiler pressure is so great that the engine must take steam for .7 of its stroke. In spite of the sensitiveness of the governor the weights are so adjusted with relation to the working parts that their inertia tends to check hunting when the load is extremely varied. Special types are in addition manufactured for small powers, and though it is a well known fact that, as a rule, small engines are usually not of the same perfection of workmanship as the larger sizes, we feel sure that those who are planning for small isolated plants will take an interest in the neat little Weston engine. The larger sizes are likely to have a demand for regular and heavy work, and it is worth mentioning that a new form of tandem compound engine embodying the same excellent peculiarities of valve motion has been brought out. All the forms are characteristic high speed engines running at from 450 to 200 revolutions per minute.



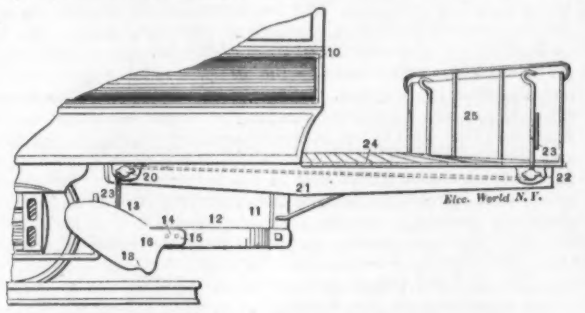
THE NEW WESTON AUTOMATIC ENGINE.

McLain's Track Cleaner.

The accompanying cut represents an invention of William R. McLain, of the Des Moines Street Railway Company, Iowa.

This invention is an improved and combined pilot and plow or scraper especially adapted for the removal of moderate falls of snow, mud or other obstructions, without any damage to the plow itself, since by reason of the construction the blades yield in such a manner as not only to avoid damage to the apparatus but also to facilitate the removal of the obstruction.

To an arm depending from the under side of the car floor are pivoted independently two plow beams, to the outer ends



The McLain Track Cleaner.

of which beams the blades are secured by bolts, which latter extend beyond the blades so that rubber blocks can be interposed between the nuts of the bolts and the rear face of the blades.

The plow and beams are raised independently by means of flexible connections running over the pulleys secured to the boot leg, to a point above the platform where the flexible connections are secured to a hooking lever device which engages the dashboard.

When the blades meet an obstruction they turn torsionally against the rubber blocks so that a constantly increasing force is applied to the obstruction, finally depositing the same to one side of the track, the blades yielding to such an extent as to avoid damage. An angle iron is also secured to the pedestal which limits the torsional movement of the blades.

These scrapers were used by the Des Moines Street Railway Company last winter and were a grand success; only cars with scrapers could be used in snowy weather.

India-Rubber in Madagascar.

Among the forests of Madagascar, india-rubber is everywhere to be found, but, says the Chancellor of the French Residency at Antananarivo, in those places which are easy of access it is beginning to be scarce, and the prices have considerably increased. The diminution in the supply is to be attributed, among other causes, to the cutting of the trees at the foot, in order to more easily arrive at the milk. India-rubber enters, to a very great extent, into the exports of the country, and, in order to encourage this industry the government ought, in M. Anthouard's opinion, to look carefully after the preservation of the forests, endeavor to prevent fires, and to induce the natives to abandon their habit of cutting down the trees bodily. In these circumstances, Madagascar india-rubber might, he thinks, successfully compete with the Para product.

Street Railway Mileage.

The following statistics have been compiled from returns recently made by street railway companies in the United States and Canada, including all the returns down to the middle of September. These are believed to be as reliable as it is possible to make such data, and are due to the labors of our esteemed contemporary, the *Street Railway Journal*.

The total number of miles of street railways in the United States and Canada is 11,029, of which 5,442 are operated by animal power, 3,000 by electric power, 1,918 by steam power, and 660 by cable power. The total number of cars employed in the street railway traffic of the United States and Canada is 36,517, of which 25,424 are operated by animal power, 6,732 by electric power, 3,317 by cable power, and 1,044 by steam power. The total number of companies operating street railways in the United States and Canada is 1,003, of which 412 operate electric lines and 54 operate cable lines. The number of horses employed in street car service is 88,114, of mules 12,002, and of steam motors 200. It is interesting to note that since November, 1890, the number of horses employed on street railway lines has fallen from 116,795 to 88,114; that is, 28,681 in one year. At this rate it will not take long to emancipate the horse from street railway business.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

Chicago Quotations.—Col. S. G. Lynch, broker, 153 Monroe street, Chicago, furnishes quotations on telephone and electric light stocks as follows:

TELEPHONE STOCKS.

Chicago	$230@	$235	Cumberland	$60@	$62
Central Union	50@	51	Wisconsin	118@	120
Michigan	82@	83	Bell of Missouri	175@	180
Great Southern	30@	32	Iowa Union	20@	22
Colorado	34@	36	Missouri and Kansas	54@	56
Rocky Mountain Bell.	40@	43			

ELECTRIC LIGHT STOCKS.

Chicago Arc Light and Power	$97@	$99	Chicago Edison Co. $145@$150

Messrs. August Belmont & Co., of New York, and Messrs. Lee, Higginson & Co., of Boston, announce in another column that they will receive subscriptions at par for $3,000,000 seven per cent. cumulative preferred stock of the Westinghouse Electric and Manufacturing Company. The authorized capital stock of the company is $10,000,000, of which $4,000,000 is preferred stock. The balance, $1,000,000, of the preferred stock above the amount offered now for subscription will remain in the treasury to meet the future requirements of the business. The reorganization of the Westinghouse Electric and Manufacturing Company is amply explained by the statement embodied in the advertisement, presenting a wonderful and constant growth of the sales, which in 1890 show a total of $4,289,086.81, an amount that will be much increased by the general introduction of electric lighting and other features of their manufacturing specialties, opening to the company a field of much greater magnitude in the present and near future, for which the additional capital of the new company will be available. The company will continue to have the benefit of the mechanical and engineering ability of its founder, Mr. Westinghouse, while among the directors there are many names of high financial standing, known for their conservatism and prudence. The subscription for the entire amount of the preferred stock now offered has been guaranteed by underwriters in this country. The public is now invited to participate in the same. The subscription lists will be opened in New York and Boston on Wednesday, Oct. 14, and will be closed at 3 P. M. on Oct. 16.

NEW INCORPORATIONS.

The Chicago Electric Wire Company, of Chicago, Ill., has been incorporated, with a capital stock of $1,000,000. The incorporators are J. W. Dyrenforth, C. N. White and J. N. Hansom.

The Buffalo, Kenmore and Tonawanda Electric Railway Company, with a capital stock of $150,000, has been formed to construct an electric railway about eight miles long from Tonawanda to Amherst, N. Y.

The Chicago and Central American Company, of Chicago, Ill., has been formed, with a capital stock of $5,000,0.0, to deal in Central American railroad and telegraph stocks. R. L. Martin, D. A. Courter, J. H. McGill and S. F. White are the incorporators.

The Voltaic Electric Company, of Chicago, Ill., with a capical stock of $3,000,000, has been formed to manufacture, introduce and sell electrical machinery, apparatus and appliances. The incorporators are John L. Johnson, Ira S. Baker and Erastus N. Fay.

The Baltimore Gas Fixture and Art Metal Manufacturing Company, of Baltimore, Md., has been incorporated with a capital stock of $6,000 to manufacture gas and electrical and art metal work. The promoters are Peter Krits, George W. Craig and Herman Schussin.

The Citizens' Electric Light and Power Company, of Pueblo, Col., has been formed with a capital stock of $100,000 to furnish electricity for light, heat and power, and also to deal in all kinds of electrical supplies. John F. Vail, John H. Black and John W. Finlan, of Pueblo, are the incorporators.

The Holekamp, Grady & Moore Instrument Company, of St. Louis, Mo., has been incorporated, with a capital of $10,000, to manufacture and deal in physicians' supplies, surgical and electrical implements, etc. R. A. Holekamp, W. R. Grady and J. W. Moore, all of St. Louis, Mo., are the organizers.

The Elgin Electric Heating Company has been organized at Elgin, Ill., with a capital stock of $10,000, for the purpose of manufacturing machinery, implements and apparatus for applying heat for mechanical purposes and heating by electricity. The directors are Chas. E. Jones, F. R. Allen and R. N. Botsford.

The Algiers Ice Manufacturing Company, of New Orleans, La., has been formed with a capital stock of $50,000, for the purpose of manufacturing ice, operating the city water-works, and furnishing power for electric lights. The incorporators are William Wenzel, Peter Blaise and George D. Hite, all of New Orleans.

The Kalispell Lumber and Water Power Company, of Kalispell, Mont., has been incorporated with a capital stock of $25,000 for the purpose of building, buying, selling, etc., mills, electric light and power works, etc. Charles E. Conrad, William G. Conrad, William H. Smead and David Lamont are the promoters.

The J. C. Chambers Electric Sanitarium and Supply Company, of Detroit, Mich., has been organized, with a capital stock of $50,000, and will manufacture electrical, medical and surgical supplies and appliances. The interested parties are Josephus C. Chambers, Thomas Rollinson and Charles C. Wilmot, all of Detroit, Mich.

The Shawnee & Straightsville Electric Light Company has just been incorporated at Shawnee, O., with a capital stock of $25,000, for the purpose of furnishing electricity for light, heat and power. The gentlemen interested in the corporation are David L. Sleeper, A. S. Bethel, E. McLellan Posten, William L. Kessinger, Herbert S. Burson.

The North American Manufacturing Company, of Elizabeth, N. J., has been incorporated with a capital of $100,000, to manufacture electrical and mechanical apparatus, with branches at Plainfield and New York. Asa D. Phillips, of Plainfield; Samuel D. Hillman, of New York; and Charles W. Leveridge, of Brooklyn, are the incorporators.

The City of Oklahoma Light Manufacturing, Canal and Water Power Company has been formed at Jersey City, N. J., with a capital stock of $150,000, for the manufacture of light by electricity. Its promoters are Wm. D. B. Janes and Jno. H. Bell, of Brooklyn, N. Y.; E. B. Merrill, New York City, and Frank L. Clark, Jersey City, N. J.

The Anglo-American Gas Control Company, of San Francisco, Cal., has been organized with a capital stock of $200,000, to manufacture, buy, sell, etc., etc., governors, gas burners, lamps, etc., and also to manufacture and sell gas and electric light. L. A. Kelley, Geo. T. Gaden, S. F. Long, H. L. Tatum, J. J. Bowen, H. A. Williams and J. P. Langhorn, of San Francisco, are the organizers.

The Bogota Water and Light Company, of Bogota, Ill. has been formed with a capital stock of $5,000 for the purpose of constructing, maintaining and operating works for supplying water for extinguishing fires, etc., and for supplying and distributing electricity for electric lights, etc. A. J. Munn, Jr.; Henry McDougall, James C. Menair, Laura Hopper, Peter E. Hopper, Peter Bogert, Jr.; Herbert F. Munn, George Foster, Samuel Munn and Robert Dyatt are interested in this company.

The Deposit Electrical Company, of Deposit, N. Y., has been organized with a capital of $12,000. Charles P. Knapp, Charles A. Wheeler, E. F. Smith, C. N. Stowe, B. E. Radeker, C. M. Putnam, A. E. Wickwire, A. S. Wickwire, Charles R. Smith, Paul Devereaux, C. H. Putnam and J. W. Kniskern are the members. The following are the officers: C. M. Putnam, president; Charles R. Smith, vice-president; Charles N. Stow, secretary; Charles A. Wheeler, treasurer. An entire plant of electrical machinery has been ordered, and the work is to be pushed.

AFFAIRS OF THE COMPANIES.

The Gold and Stock Telegraph Company Stockholders have re-elected the old directors as follows: Norvin Green, Russell Sage, Jay Gould, George J. Gould, Thomas T. Eckert, W. M. Bliss, Charles G. Landen, Charles A. Tinter, John A. Van Horne and W. A. Wheelock. The directors re-elected Norvin Green president, and T. T. Eckert and John Van Horne, vice-presidents.

Bell Telephone Output.—The following statement shows the output of telephones for the period named:

Month ending Sept. 20:	1891.	1890.	Inc.	Dec.
Gross output	5,552	5,723	171	.....
Returned	3,641	2,358	1,283	.....
Net	1,911	3,365	.....	1,454
From Dec. 21 to Sept. 20:	1890-91.	1889-90.	Inc.	Dec.
Gross	53,941	48,409	5,532	.....
Returned	31,349	20,110	11,239	.....
Net	22,592	28,299	..	5,707

Bell Telephone.—One of Boston's millionaire investors is reported as saying concerning this stock: "Bell telephone will sell 40 points higher, will pay $3 per share quarterly, $6 per share extra next July as usual, and is also good for two more 'right' issues worth upon present quotations $15 and $12.50 respectively, but more of course as the stock advances. I figure upon rights and cash dividends the next two years aggregating $60 per share. I base my figures of rights upon the fact that the company should extend its long distance service into Chicago before the opening of the World's Fair." The Boston *News Bureau* says that an investing holder of more than 1,000 shares of Bell Telephone stock figures the value of the company's assets at $300 per share, as follows:

Long Distance Telephone Company at cost	$5,000,000
Telephone rental contracts on net basis of 10 per cent	15,000,000
Stocks in local and territorial exchanges ($27,000,000)	25,000,000
Total	$45,000,000

Or for the $15,000,000 Bell Telephone capital stock a value of $300 per share.

Mexican Telephone Company's Affairs.—A stockholder of this company, desiring information of its affairs, sought it at headquarters and received in reply the following letter:

DEAR SIR: Your favor of the 27th ult. came duly to hand, but the pressure of business and absence from the city have prevented my answering you any earlier. Regarding the patents, they do not expire until 1896, and the company will take measures to have them extended further, if it is deemed advisable at that time. As regards the value of the stock, my own impression is that it is cheap at the present price. The company was never in better condition than it is to-day, all outstanding obligations and claims have been settled; in fact, the company has no outstanding debts whatever. The earnings are steadily increasing, and we are receiving regular remittances from Mexico and have accumulated a considerable balance. As regards the dividend, I do not feel at liberty to express any opinion, but I would merely say that, based on the present earnings, I should think the directors would be justified in declaring a dividend before long, but I am personally opposed to paying dividends until I feel that the condition of the company will warrant them being continued regularly. I am always happy to give you any information I can. I remain, dear sir, yours very truly,

ROBERT COLGATE, President.

Commenting on this letter the Boston *Herald* says: "In August a round dozen of instruments were added to those previously in use, swelling the revenue a good $1,000 per year. The revenue is, then, increasing, and the company ought to show $20,000 at least above operating expense and ordinary repairs the current fiscal year. Whether a dividend will be paid is problematical. The company has work in hand, altering its poles, etc., as required by its new license, which will call for an expenditure of some $22,000 or $23,000, and which can be completed in a half year or in two years, as may be thought best. This alteration is expected to increase the efficiency of the service, and, hence, the earning powers of the company. This alteration must be paid for in some way; if from current revenue, dividends must be delayed a little; if as construction, the money will have to be raised in a different way. It is a little early to discuss methods as yet. The company appears to be doing the best that it has ever done, and that the management is alive to its opportunities and surroundings shareholders will probably learn a little later. It has been discovered that the company can reorganize its capital if it desires under the law passed at the last session of the New York Legislature."

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
167-177 TIMES BUILDING, NEW YORK, Oct. 5, 1891.

The United States Electric Railways Company, at 10 Wall street, New York City, is apparently overrun with applications for equipment work, as it desires us to state that that organization has no connection and should not be confounded with the United States Railway Equipment and Construction Company.

Chas. A. Schieren & Co. have recently taken an order from the Davenport Gas Company, of Davenport, Ia., for about 110 feet of 48-inch double belting, and in addition to this the necessary dynamo belts. This company has also taken an order from the South Bend Electric Company, of South Bend, Ind., for about 110 feet of 48-inch double belting, about 100 feet 20-inch double belting and all the necessary belts for the dynamos.

"How to Keep Boilers Clean" is the title of a little pamphlet just issued by James F. Hotchkiss, 112 Liberty street, New York. It is principally a description of the Hotchkiss mechanical boiler cleaner, although a part of the pamphlet is taken up with a large amount of useful information, consisting of tables, etc., for steam users and engineers. A very complete list of the parties using the Hotchkiss cleaner is given at the end of the pamphlet.

Messrs. Thompson & Robertson, of 258 Broadway, New York City, were represented at the Montreal Convention by Mr. Louis Walsh, the manager of the sales department, and while there Mr. Walsh closed sales with the following parties: Mr. Thomas Messmer, of Montreal; The Toronto Construction and Electrical Supply Company, of Toronto; The Illinois Electric Material Company, of Chicago; The Cleverly Electrical Works, Philadelphia, Pa.; Royce & Marean, Washington, D. C.; The E. S. Greeley & Co., New York City, and Clower, Harris & Co., of Dallas, Tex. It will be remembered that this firm is the sole manufacturer of the Fibrous battery, both dry and liquid, and of the Leclanché Fibrous porous cup, and these sales in all parts of the country, taken in a single week, from parties who were given an opportunity of inspecting the batteries in actual operation, speak well for the impression made by the goods on the visitors at the Montreal Convention. L. H. H.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 28, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., Oct. 3, 1891.

Rutland.—An electric line is to be built to West Rutland soon.

C. J. Titus, of C. J. Titus & Co., the hustling supply dealers of Malden, was in town Saturday last.

The Electric Gas Lighting Company reports business very lively on the Porter motor, needle annunciator and Samson battery, three of a kind hard to beat.

Providence is listening to arguments pro and con relative to the respective merits of company and municipal lighting. The favors seem pretty evenly divided so far.

Belfast (Me.)—A party of Boston capitalists are looking over the ground and propose to build an electric railway to the Northport Camp Grounds, a distance of four miles.

The T.-H. Company are rushing the huge generators for the West End Street Railway, but the work is necessarily slow. Special machinery had to be built before anything could be done.

The Conductors of the New York, New Haven and Hartford Railroad Company hold a fair at New Haven during the week of Oct. 12-17, in connection with which there will be several electrical exhibits, including those of The E. S. Greeley & Co. and the Hall railway signal.

The Interstate Electric Street Railway, connecting Providence, Attleboro, North Attleboro and Pawtucket, and to be some 40 miles long altogether, is well under way; a large force of men is employed and the work is being well done. It is expected that the rails will be all laid before snow flies.

Mr. W. A. Giles, formerly with the Edison General Company, in charge of the mining department in Pennsylvania, has accepted the general selling agency for the J. T. Case Engine Company, of New Britain, Conn., and the Wing Disc fan for the States of Pennsylvania and West Virginia, with headquarters at Pittsburgh.

Cambridge, Mass.—At the meeting of the Cambridge Aldermen, held last week, it was voted to give a hearing Oct. 21 in regard to additional location of car tracks on Brattle and Mount Auburn streets, on which cars will be operated by electricity, and to give a hearing Oct. 13 in regard to taking land for the widening of Main street to the Cambridgeport National Bank.

The Electric Plant at the Thomson-Houston Electric Works, in Lynn, is now operating 295 arc and 2,700 incandescent lights, while on the motor circuit there are over 100 motors from ⅛ h. p. up to 100 h. p.; there are also 54 telephones throughout the factories, all of which are kept working in apple-pie order under the efficient direction of Mr. F. C. Bates, the electrician in charge.

New Haven, Conn.—Waller, Cook and Wagner, corporation lawyers of Wall street, have purchased two of the street railway systems of New Haven, the West Haven Horse Railway Company's and the Winchester avenue company's. The purchasers are acting in the interest of the syndicate of Eastern capitalists which recently purchased the street railways of Detroit, Mich., for $7,000,000. The New Haven roads purchased are profitable and will be equipped immediately with electricity and other appliances for rapid transit. Ex Governor Waller is very reticent about the money paid in the transaction.

The Thomson Scientific Club of Lynn, Mass., has now a membership of about 125. Since moving into its new quarters, about a year since, the success of the club has been assured. On Thursday, Oct. 1, Mr. J. J. Berger read a paper on "The Hoosac Tunnel," and this will be followed by a regular series. The club has also decided to have a course of lectures, and negotiations are now under way with several prominent gentlemen eminent in the electrical and mechanical field. The officers of the club are: J. E. Randall, president; J. B. Cahoon, first vice-president; H. G. Reist, second vice-president; Franklin Sheble, secretary, and J. B. Barr, treasurer.

C. A. B.

SOUTHERN NOTES.

NORFOLK, Va., Oct. 3, 1891.

Summerville, S. C.—A small electrical plant will be put in the Pine Forest Inn.

Shelby, N. C.—A franchise has been granted G. M. Webb and others to build an electrical railroad.

Edgefield to Augusta, S. C.—The telephone between Edgefield and Augusta has been completed.

Pennington Gap, Va.—S. H. Hale will erect a saw and planing mill here and wants estimates on dynamos.

Little Rock, Ark.—Some considerable extension of the City Electric Street Railroad is contemplated.

Atlanta, Ga.—The electric power plant of the Consolidated Street Railway Company will have new machinery added.

Anderson, S. C.—The electric light company is agitating the enterprise of running electric cars through the principal streets.

Baltimore, Md.—A contract has been awarded E. B. Smith & Co., of Philadelphia, for building the North Avenue Electric Railroad.

Towson, Md.—An electric light company from Indiana is investigating the question of the establishment of an electric light plant here.

Hagerstown, Md.—The United Silk Manufacturing Company proposes putting an Edison incandescent electric light plant of over 200 lights capacity in its mill.

Moundsville, W. Va.—The City Council has been petitioned to grant a franchise to the Moundsville Mining and Manufacturing Company to operate an electrical railroad.

Memphis, Tenn.—An electric power plant will be erected for the purpose of operating the Raleigh Springs Railway Company. Eugene Lynch has secured the contract to build it.

Baltimore, Md.—Two railway companies, namely, the North Baltimore Passenger Railway Company, and the Central Railway Company, have applied for authority to use the trolley system.

Elberton, Ga.—Electric lights and water-works are reported assured since the introduction of a bill in the Legislature authorizing the issuing of $40,000 of bonds. The mayor can give information.

Greensboro, N. C.—R. M. Douglas is the president of a newly

organized company known as the Greensboro Street Railway Company. They will build an electrical road, with horse-car connections.

Baltimore, Md.—It is said the financial arrangements for building the South Baltimore electric railway have been completed and work will be commenced shortly. It will run from Ferry Bar to Curtis Bay.

Chattanooga, Tenn.—It is stated that the extension of the electrical railroad to Morrison Springs has been commenced by the Chattanooga & Northside Street Railway Company, and the work is now fairly under way.

Leesburg, Va.—Sealed proposals for lighting the streets of Leesburg by electricity will be received by the mayor of Leesburg, up to 12 o'clock M., Oct. 15. The proposals must be addressed to the mayor and marked "Proposals for Lighting Streets."

Knoxville, Tenn.—A franchise has been secured by S. W. Miller, of Findlay, O.; Samuel Kinney, Major Webb and others, to build the Market Square and Southside Railway. It is to be operated by electric power, and will at first extend only to Middlebrook Park, a distance of five miles.

Columbus, Ga.—Ground has been broken for the Newnan Light and Power Company, and a building for the dynamos and steam plant will be erected at once, together with coal sheds, etc. The main building will be 22 × 50 feet. The dynamos and engine are on the way, and the entire plant will be completed not far from the date promised by the contractors, Oct. 22.

Charlestown, W. Va.—The City Electric Light Company, of which Wm. Campbell, of Charlestown, is president, will construct an electric light plant here at an estimated cost of $16,000. The company desires to engage a consulting engineer. Estimates for an incandescent and power system, motors, dynamos, storage batteries, belting, and all electrical supplies are wanted.

Washington, D. C.—The Potomac Electric Company, which proposed to transmit electrical power to the city from the Little Falls of the Potomac, has met with a serious obstacle in the shape of an order of the District Commissioners compelling the company to cease the erection of poles in Georgetown and remove those already up. This order was based upon the report of the police authorities, from which it appeared that the company had not complied with the terms of its permit, which required that the consent of the abutting property owners should be first obtained.

Augusta, Ga.—This city can safely promise one of the finest expositions in the country this year. The friends of the enterprise enthusiastically claim that it will not be surpassed, and it is doubtful if it will be equaled by any American city. It is futhermore claimed that the electrical display will be the handsomest one ever arranged in America. The electrical display will occupy the space in the rotunda, filled in 1888 by the United States government display. It will be grouped around the electric elevator to the observatory, and the indications are that this space will not be large enough to hold all the electrical appliances that are booked to be present The Thomson-Houston company has just closed for space, and will make a fine exhibit of electrical rock drills, steam pumps, hoisting machines, motors, dynamos, etc. The Germania Electric Company will show dynamos, motors, etc., operating printing presses and other machinery, incandescent lamps, etc; the Holtzer-Cabot company, of Boston, electric annunciators, gongs, watchmen's clocks, lighting apparatus, etc; the Consolidated Electric Manufacturing Company, a large and magnificently arranged display of electric appliances. The Whittier Machine Company, of Boston, has already arranged to erect an electric elevator. Porter & Levitt, of Providence, will make a handsome display of electric motors. Besides these there are other electrical supply companies that will occupy space in the electrical exhibit. V. N. B.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
465 The Rookery, CHICAGO, Oct. 3, 1891.

Quincy, Ill.—The hardware house of H. & J. Tenk has put in the first electric elevator ever used in this city.

Fort Wayne, Ind.—The shop at the electric works is busy on two 3,000-light incandescent dynamos for a St. Louis, Mo., plant.

Madison, Wis.—The electric light company is putting in meters, so that patrons will pay for just what they get and nothing more.

The Sperry Electric Mining Machine Company, of Chicago, is shipping some heavy fuses for street railway circuits; also fuses with copper ends.

Windsor, Mich.—W. G. Turner has purchased the plant for a 1,000-lamp incandescent lighting system which will arrive next week and at once be put in working shape.

Milton, Wash.—The proposition to bond Milton for $10,000 for the extension of the water system and the putting in of an electric light system was carried by a big majority.

The Electrical Construction Company, Chicago, is finishing its extensive contract on the Virginia Hotel, which it has wired throughout, including outlets for over 1,500 lamps. It has also completed the wiring of two out-of-town theatres.

Mr. G. H. Keating, of Bay City, Mich., representing the H. M. Loud & Sons Lumber Company, of Oscoda, Mich., was a welcome visitor in Chicago this week, and carried away pleasant memories and a pocketful of orders for poles and cross arms.

Mr. La Fayette Cole, the traveling representative of Holmes, Booth and Haydens, is in Chicago this week en route home from a long trip on the Pacific slope. Mr. Cole carries home some nice orders in addition to some large ones already forwarded.

Butte City, Mont.—The Flint Creek Electric Power Company, of Butte City, Mont., Thomas T. Baker, president, and J. H. Parker, secretary, will erect a mammoth electric power plant here, and estimates for an electric power system, motors, dynamos, generators, wires and poles are wanted.

Indianapolis, Ind.—City Attorney Bailey has drawn up a contract for the city allowing the Jenney Electric Motor Company to erect poles and run wires outside the territory in which wires must go underground. The new company is putting a plant in the old skating rink building on Virginia avenue.

Defiance, O.—The City Council has accepted the proposition of the Defiance Light and Power Company to furnish 60 electric lamps to the city at the rate of $90 per light, the lights to be burned 3,000 hours each for a term of five years, with the privilege of council to divide the time as deemed most advantageous.

Lake City, Colo.—Work has been begun on the new electric light plant to be put in here. Mr. G. W. Crowe, the originator of the plant, is now in Denver, making arrangements for the necessary appliances. The power will be obtained from the old Ocean Wave Mill, and it will not be many weeks before Lake City will be lighted by electricity.

Mr. George C. Pyle, the electrician of the National Electric Headlight Company, of Indianapolis, Ind., is in Chicago on business relative to the introduction of his electric headlight on some of the western roads. Over fifty locomotives are now supplied with the Pyle headlight and so great is the satisfaction given that the number is constantly increasing.

Greenville, O.—In our issue of Sept. 19, a statement was made that the Thomson-Houston Electric Company had made the lowest bid for the plant at Greenville, but we have since been informed that the Ohio Construction Company, of Norwalk, O., had made the lowest bid. This company's bid was for the plant complete in every detail for $4,692, including 40 lamps, while the Thomson-Houston Company's bid was for 28 lamps only.

Fuse Wire.—The importance of having fuse wire on fuse strips of proper carrying capacity is well known. Yet this point is often neglected till considerable loss occurs through the fuse having an equal or greater capacity than the wire to which it is attached. The Sherry Electric Mining Machine Company, of Chicago, is furnishing the trade with strip and wire fuses of guaranteed safe carrying capacity which can be relied upon implicitly to "blow" on an increase in quantity of the current.

The Great Western Electric Supply Company is having splendid success with its Sun arc lamp, which is manufactured by the Sun Arc Lamp Company, of Chicago. It has installed a number of series sets on various railroads throughout the West, and in every case the lamps are giving most excellent satisfaction. They operate either five, six or seven in series, on a 500 volt railroad circuit, and give a beautiful white light, without flickering. For lighting car barns and power houses, as well as street crossings and areas through which railroads pass, they cannot be excelled.

Danville, Ill.—The putting up of the wire for the new electric fire alarm system has been interrupted by the interference of the electric light company. By the order of the electric light company their linemen removed from the company's poles all the wires of the electric fire alarm system, as well as the boxes which had been placed thereon. The gentleman who represents the fire alarm is not in the city and the erection of the wire had been intrusted to C. W. Gregory. No one had received any notice that the wire and boxes were to be removed, neither had they been requested to remove them.

Newport, O.—Chancellor J. W. Menzies has dissolved the injunction that restrained the City Council from voting to rescind the contract with the Suburban Electric Light Company. Judge Toney, of Louisville, ordered the City Council to rescind the contract with the Suburban Electric Light Company on the grounds that the Newport Light Company had the exclusive right to light the city, and the Electric Light Company enjoined the city from interfering with her contract with it to light the city. Under the above order the City Council may vote to annul the contract with the Electric Light Company.

Indianapolis, Ind.—The Edison General Electric Company was recently made defendant in a suit brought in the Superior Court for $75,000 damages, the Indianapolis & Broad Ripple Rapid Transit Company appearing as the plaintiff. The averments are that the defendent agreed to complete the construction of the road by Aug. 1, 1891, at a cost of $192,000, but not an inch of the line has been completed; that subsidies and donations amounting to $25,000 had been promised on condition that the road should be built, and by the failure the sum was lost to the plaintiff; that the defendant's failure to perform the contract caused a loss of franchises worth $25,000, and of profits aggregating $10,000, wherefore damages are demanded in the sum named.

Electrical Congress in 1893.—President Bonney, of the World's Congress Auxiliary, has appointed the following committee to make the preliminary arrangements for an electrical congress: Prof. Elisha Gray, chairman; Col. Robert C. Clowry, vice-chairman; B. E. Sunny, C. H. Summers, G. H. Bliss, and F. S. Gorton. Several other prominent gentlemen have been appointed to serve. The committee will have charge of all forms of electrical application, excepting electrical engineering, which has been assigned to the General Committee on Engineering Congresses, and electrical therapeutics, which has been assigned to the Committee on Health and Medicine. The Electrical Congress will deal among other things with telegraphy, telephony, the phonograph and telautograph, the electric light, the electric motor, and all other practical applications of modern electricity, except those otherwise especially assigned. The local committee will be assisted in its work by an Advisory Council of the World's Congress Auxiliary, consisting of the most distinguished electricians in different parts of the world.

A Highland Park Electrical Factory.—Frank P. Hawkins has sold 50 acres in the south end of Highland Park, a suburb of Chicago, for Arthur C. Thompson at $500 an acre. The purchaser is the Gray Electric Company. This company will locate a plant for the manufacturing of the "Telautograph" especially and for the manufacture of all kinds of electrical supplies and appliances incidentally. Plans for this plant have been drawn by W. W. Boyington. The main building will be 140 × 60 feet with a number of smaller supplemental structures. The main building will have a handsome front overlooking the lake. The front portion of the building will be three stories high of pressed brick. In the centre will be a handsome entrance which will be carried up into a central tower, in which will be placed a large electrical clock. The remainder of the building will be two stories in height. The works will give employment to 100 hands at first, and later on will employ three times that number. The company has plans for the development of the tract purchased as a park, to be occupied by the homes of employés.

The Electrical Engineering Company, of Chicago, is making a handsome installation in the Fair building—the Macy's of Chicago—which includes eight 50-light Standard arc dynamos and three Standard incandescent dynamos of 1,000 lights capacity each, driven by the compound automatic engines manufactured by the Phœnix Iron Works Company, of Meadville, Pa., three engines of 200 h. p. each being already in service. Sperry triple carbon arc lamps are distributed throughout the building and controlled from a Sperry arc switchboard. The incandescent switchboard when completed will be a very handsome one and will contain 90 double pole Andrews switches, in addition to 15 Andrews switches of 100 ampères, three of 800 ampères each and nine of 500 ampères each, all of the Andrews type and manufactured by J. Lang & Co., of Chicago. The Fair building when completed will be twelve stories high and cover a full half block or 66,500 square feet of land for which an annual rental of $154,000 is paid. (It is worthy of note that a portion of this land, less than one-half, cost the late owner but $5,000 and he refused $1,500,000 for it). Within this building 4,000 persons will be employed and the floor space will amount to 887,250 square feet—over twenty acres. F. DE L.

KANSAS CITY, Mo., Sept. 23, 1891.

Albany, Mo., is figuring on a municipal plant and will call on several Kansas City firms for bids.

Mr. Geo. S. Searing, of Kohler Bros. and Grier, Chicago, is securing several orders in this territory.

Horton, Kan., using the storage battery system, is going to increase the present capacity to about double.

Chanute, Kan., has appointed a committee to investigate incandescent lighting with a view of putting in a plant.

Mr. M. R. Gardner, manager of the H. C. Underwood Manufacturing Company, Wabash, Ind., was in town this week.

The Franklin and Gate City Electric Companies are busy making preparations for an exhibit at the coming exposition.

Mr. Thos. F. Clohesey will put in 400 incandescent lamps at the Interstate Exposition. He will also furnish power for light machinery.

The Kansas City Electrical Works have been appointed general agents for the Interior Conduit and Insulation Company, of New York.

St. Joseph, Mo., is still wrestling over the question of paying the remaining $16,000 and interest to the Excelsior Electric Light Company for its plant. Already $47,000 has been paid.

Mr. C. A. Ross, of the Thomson-Houston Company, closed several contracts last week, among them a 45-arc plant at Memphis, Mo.; one 43 arc at Maryville, Mo., for the Maryville Electric Light and Power Company; two 30-arc at Webb City, Mo.; one 45 and one 30-arc at Moberly, Mo., for the Moberly Gas and Electric Company, and two 650 incandescent alternating, at Salina, Kan., for the Salina Light and Power Company. H. D. E.

CANADIAN NOTES.

Stratford, Ont.—This town is going in for an electric light service.

Selkirk, Manitoba.—An electric light service will be put in operation here shortly.

Digby, N. S.—The electric light company expects to have everything in full operation by Nov. 1.

Mr. G. McPhillips proposes to make a survey at an early date of the probable line over which the Amherstburg extension of the Sandwich, Windsor and Amherstburg electrical railway will have to run.

Prince Albert, N. W. T.—The Electric Light Company is stretching wires, and has run a number into several of the business houses on River street. Everything looks favorable for the light being in operation within a week or two.

Peterborough, Ont.—There are two syndicates applying for the franchise to construct an electric street railway in this town, the one comprising town capitalists and the other principally composed of gentlemen connected with the Edison company.

Sydney, Nova Scotia.—Last week a number of leading colliery managers inspected the Jeffery electric coal cutter installed at the Gardiner mine, Sydney, by A. Robb & Sons, of Amherst. Machine cutting will likely be extensively introduced here. Sydney has two electric lighting companies in full blast, known as the Edison and Robb companies.

A New Cable.—A new cable to the West Indies is among the probabilities. F. N. Gisborne, official electrician to the government of Canada, has recommended the construction of such a line, after visiting the West Indies and collecting statistics as to the volume of business that may be expected from each island. His report has been submitted to a London syndicate. The line recommended will be an extension of the cable between Halifax and Bermuda, and will terminate at Demerara, touching on its route Fortune Island and the Island of Jamaica, and passing through the Caicos passage.

Railway Franchise in Toronto.—The Toronto City Council having acquired the right to the street railway from one company has straightway leased the road for twenty-five years to another company. In the terms of the lease it is provided that the company might adopt some other motive power than horses, the Council to select the particular motor. Public opinion seems to be about evenly divided between the electric system and the cable car. The city engineer has been sent to the United States to inquire into systems in use in the large cities there. The Ottawa Electric Railway Company, in adopting the trolley system, reserved to itself the right of substituting for it the system of storage batteries.

Hamilton, Ont.—Work has been commenced on the new building of the Hamilton (Ont.) Light and Power Company. The new directors intend making radical changes in the system of the company, and will spend $30,000 or $40,000. The new building will have a frontage of 72 by 137 feet and will be of red brick with a stone foundation and corrugated iron pitched roof. Being especially adapted to the company's requirements it will be but one story high, but will give a floor area of 8,000 square feet, capable of accommodating a plant with a capacity of 6,000 incandescent lights, 400-h. p. generators, and 500 arc lights. New dynamos, two new twin engines of 600 h. p. each, and other new apparatus and machinery will be added as the new building is completed.

Litigation.—The hearing in the case of the New Brunswick Telephone Company vs. the St. John Gas Light Company (Westinghouse alternating system) took place last week. The questions involved in this litigation are similar to those that have come up before the courts in "the States." The plaintiffs' claim in brief is that they have a right to use their system in a normal condition, and that the defendants have spoiled their circuit by stretching wires along which strong currents of electricity are passing too close to their wires. Being first in the field, the plaintiffs contend that the defendants must lay their wire in such a way that it will not interfere with the telephone wires at whatever cost. The defendants' answer is to the effect that if plaintiffs had used the McClure system from the beginning, there would have been no substantial interference with their operations by defendants.

Ottawa.—The Mayor wrote to the Council last week that as frequent observations of the two systems of street car service in Ottawa showed the great advantage of the electric system, and as he was aware that the rate payers of the city were desirous of seeing the city fully equipped with the latest inventions for quick transport of passengers, he would suggest for the full consideration of the Council whether or not it would be advisable to invite the Ottawa Passenger Railway Company to consider the great advantages it would be to the whole city to take steps to convert the system of operation of their road to the use of electric motors instead of by the present means at their disposal. The Chaudiere Electric Light Company received three dynamos with a capacity of between 3,000 and 4,000 lights. They are being put in position and will be operated immediately.

Electric Roads in Montreal.—Montreal is now perturbing itself over the question of electric roads. Municipal authority is about to be granted to the Montreal Elevated Railroad Company to construct and operate an overhead system. There are several dubious points in the ordinance, however, that may require considerable discussion to get into proper form. There is one particularly unreasonable demand in the by-law proposed to enable the electric road to be operated, and that is the requirement which specifies that the speed of the cars shall never be more than eight miles an hour, nor faster than a walk at turning corners; the last specification is peculiarly indefinite, while the first one, if enforced, would almost nullify the advantages of the electric system, for a maximum

speed of eight miles per hour means a general running speed of only five or six miles, thereby prohibiting the quickened time that is one of the most important features of electric traction.

The formation of an electric association, similar to the National Electric Light Association of the United States, is receiving attention in Toronto. A meeting was held recently to consider the question of organization. Mr. J. J. Wright, Toronto, was in the chair. The following were present: C. H. Mortimer, Toronto; George Black, manager G. N. W. Telegraph Company, Hamilton; John Yule, Guelph; J. C. McLachlan, Hamilton; J. D. McDiarmid, Aylmer S. Douglas, Kay Electrical Works, Hamilton; A. T. Anderson, Toronto; Richard Mitchel, Guelph Gas and Electric Light Company; H. H. Powell, secretary Woodstock Electric Light Company; W. A. Tower, A. B. Baylis, Bell Telephone Company, Toronto; J. Norman Smith, Toronto; W. A. Johnston, general manager Ball Electric Light Company; D. Thompson, Hamilton Electric Light and Power Company; H. Browne, St. Thomas Gas and Electric Light Company; J. Telfer, Blenheim, A. B. Smith, Inspector Electric Light Board of Underwriters. A sub-committee was appointed to draw up a basis for the formation of the association and to report at a future date. The following were selected as members of that committee: Messrs. Wright, Nichols, Thompson, A. B. Smith, Johnson, Dunstan and Yule. Nov. 26 was fixed as the date of the meeting, and Toronto the place.

ENGLISH NOTES.

London, Sept. 23, 1891.

Liverpool's Elevated Electric Railway.—The elevated railway along the docks at Liverpool is the first railway of its kind in England, the various masonry elevated lines in and around London being merely the entrances of the trunk lines into the city, while the Liverpool Overhead Railway, as it is called, is intended for local passenger traffic and for freight traffic to the numerous docks and warehouses. The cost is estimated at $2,000,000. The railway will be a double track line of standard gauge, about 6½ miles long, with stations at short intervals and frequent trains. It will be operated by electricity. The board stipulated for the right to subscribe for $500,000 of the capital stock of the company, and will lease the line rent free until a dividend of six per cent. is earned, after which it is to receive $5,000 per annum, the surplus profits being divided between the board and the company.

The Ferranti Company.—The vast operation of providing for the supply and distribution of electricity at 10,000 volts at Deptford station would have been enough to occupy the whole attention of the responsible designer and contractor, but Mr. Ferranti has been busily engaged all the time in pushing and developing an important business both in this country and in France. A fine 300 h. p. dynamo has just been completed at his London works, and it is being sent to Havre, where a central station has been erected and fitted up by Mr. Ferranti's French partner. This machine runs at 330 revolutions per minute, giving 2,400 volts. An exciter is mounted on the same shaft, and uses only 35 volts. The armature is five-eighths inch thick and has a clearance of one-eighth inch on either side. Oil circulating pumps are driven by a geared down eccentric, and pump a continuous stream of oil from a reservoir in the bed plate, through wide channels in the bearings. At Havre a similar machine has been running for 18 months with but one charge of oil. A considerable portion of the factory at Charterhouse Square is devoted to the building of transformers, in which the general principle of the earliest pattern of core is retained, with slight modifications in the arrangement of the coils. Two different kinds of meter are being made, the well known Ferranti meter rotating in mercury being made for continuous currents, and the Ferranti-Wright meter for alternating work. In order to bring the delicate wheel work into smooth running, a number of them are arranged with little vanes, against which a blast of air is maintained and thus several hundred are kept spinning round for a week or two. Mr. Ferranti has a number of most interesting inventions on hand, some of them will shortly be ready for the market, and others are being worked out in his laboratory, where a considerable staff of young engineers is engaged. Without going into particulars I may say that several of these inventions are intended to fill a want which will probably be felt as soon as certain apparatus invented by other people reveals the defects which Mr. Ferranti has foreseen, but which are not yet recognized.

The London Telephone Service.—In a recent letter to the *Times* the Duke of Marlborough made the important announcement that a telephone company, well supported financially and technically, and armed with a license from the Postmaster-General, was about to apply for parliamentary powers to "go underground," and intended at an early date to attack the National company's stronghold with the Mann system, metallic circuits and £10 rentals. I learn from good sources that this bold venture is merely a revivification of the old "New Telephone Company," formed some six or seven years ago to exploit Prof. Silvanus Thompson's ingenious transmitter, and which, after a gallant struggle, was finally crushed by the United company in the law courts, and had to go into liquidation. The New Telephone Company has been rescued from the liquidators and set on its legs again, and now proposes to attack the ubiquitous National company not only in London, but in every profitable telephone centre. The struggle, if it is ever allowed to come off, will be one of intense interest. It may, however, be anticipated that the Postmaster-General will intervene to save the London telephoning public from the enormous inconvenience of such competition. In what way he could do so, if he wished to, is not at present quite clear, although in the last resort a short Act of Parliament would settle the matter. Probably as the New company's license was granted so far back as 1884 and has never been used, it would be possible for the Postmaster-General to revoke it on these grounds. The public, however, would not care to see this done unless some guarantee were obtained from the National company that the London service should be radically improved and considerably cheapened, so that the only satisfactory way out of the difficulty seems to be the inauguration of a post office exchange with exclusive powers. The Duke of Marlborough's letter has naturally attracted much attention, and has been much criticised, the National company not lacking powerful advocates. The possibility of a £10 rental proving remunerative in London has been especially called into question. The following figures will, however, show that the thing is within the bounds of reason. The old United company had a capital of £500,000, half of which was paid away to patentees, so that at the most the London system only cost £250,000 at the start. When the National company absorbed the United it nominally paid £1,250,000 for its assets. Now allowing for additional outlay over and above the sum originally expended by the United, the *present value* of the London plant cannot be taken at *more* than £250,000. It is not, therefore, an altogether unreasonable contention that London may be telephoned for £250,000 and a seven per cent. dividend paid on that sum with £10 rentals, when the National company manages with £20 rentals to pay that dividend on a nominal capital of £1,250,000.

Answers to Correspondents.

Questions to be answered in this column must be of general electrical interest, and must be accompanied by real name and address as a guarantee of good faith. No notice will be taken of questions regarding apparatus unless enough details are given to permit a definite answer, and no dynamo or motor designing will be done.

Medical Coils.—Kindly let me know in the next issue of The Electrical World the right proportion and size of wire for getting the best results for a medical induction coil. Would you use a condenser? E. R. P.

Would refer you to The Electrical World of May 3, 1890.

More Medical Coils.—Will you please tell me why the shock from the "primary" terminals of a medical coil is always weaker than that of the "secondary" coil even at its weakest adjustment? F. X. B.

When you receive a shock from the "primary" terminals you take through your body a *secondary current* (inverse) induced in the turns of the primary coil by the sudden drop or change in the magnetism of the iron core due to the interrupter. Though the change in the magnetism is as powerful in this case as when a current is taken from the secondary coil, the electromotive force at the "primary" terminals cannot be as high as in the former case on account of the lower number of turns of wire in the primary coil.

News of the Week.

THE TELEGRAPH.

Rock Island, Ill.—The City Council has granted to the Postal Telegraph Company the privilege of erecting lines in Rock Island.

The Postal Telegraph Company is to build a telegraph line from Los Angeles to San Diego, Cal. It is said the line will be erected in 90 days. This company now has lines extending to all the principal cities of the Eastern States from Maine to New Orleans, and to San Francisco, Los Angeles, San Bernardino, Riverside and other points on the coast and in Southern California. Its cable business, done by the Mackay-Bennett company, covers Europe thoroughly. The Postal is by far the strongest rival the Western Union ever had; in fact it is the only company that has ever been able to live under the pressure of Western Union opposition.

A New Telegraph Line is contemplated from Bay City, on Tillamook harbor, to Forest Grove, Ore. A petition is being circulated to raise money for building. The distance is some 60 miles, and a company, consisting of people in the two towns, is taking a leading part. This will be of immense benefit to commerce between Portland and the harbor, and the principal idea is to facilitate trade matters, rather than to make money out of the company. The name is the Bay City and Tillamook Telegraph Company. The capital stock is put at $6,000, all of which, with the exception of $650, has been subscribed at Bay City and Forest Grove. It is expected that the Portland wholesalers and shippers to these points will make up the remainder.

Western Union Doesn't Care.—Assistant Superintendent William J. Lloyd, of the Western Union Telegraph Company, says the fact of the coalition of the Order of Railway Telegraphers and the Brotherhood of Telegraphers in Chicago is of but little interest to the company and the officials only know from reading the newspaper reports that a consolidation has been effected. The Western Union, he says, has no policy in the matter, and he doesn't know that it makes any difference. "Our men," said he, "have no occasion for organizing. They get all they want and so far as known have no grievances. Some of them now make more in a month than certain of the company's officials. They work seven hours per day and get 44 cents per hour for extra time. The company has no policy regarding the employés joining labor organizations, and, as far as I know, will not care whether its men belong to this order or not."

THE TELEPHONE.

The Telephone between Paris and London having been so successful it is proposed to connect Brussels and London. For that purpose a cable will be laid between Ostend and Dover.

The Inland Telegraph and Telephone Company, of Washington, on account of its present capacity throughout the Palouse country being insufficient to accommodate the largely increasing business, are building a second line from Spokane along the U. P. route via Colfax to Pomeroy, and will add new stations at Tekoa, Fairfield, Latah and Rockford. This new line will be constructed of the very finest copper wire. The company has 40 subscribers at Moscow and will have an exchange in operation there about the 20th of this month. The people of Penawawa, Ilia and Genesee are negotiating with the company for telephone connection, and in all probability will be included in the system before long. The company has made propositions to Kendrick, Julietta and Vollmer, which are being considered by the people of those towns. If favorable answers are received they will shortly be included among the telephone towns of this region.

THE ELECTRIC LIGHT.

Anamosa, Ia., is to have electric lights.

Orville, O., is agitating the question of electric lights.

The Zanesville, O., electric light works are to be enlarged.

Velasco, Tex.—The hotel Velasco is to have an electric plant.

Tiffin, O.—The court house and jail are to be illuminated by electricity.

Hastings, Mich.—A $15,000 electric light plant is now illuminating Hastings.

Plymouth, N. H.—Work has been commenced on the new electric light station.

Batesville, Ark.—The erection of an electric light plant and ice factory is contemplated.

Mechanicsburg, Pa.—The burgess has been instructed to receive bids for lighting Mechanicsburg by electricity.

Canton, Mo., is to have electric lights soon. The Royal Electric Company, of Peoria, Ill., will put in the plant.

Paris, Tex., is now lighted by electricity, a contract having been entered into to furnish lights at $100 each per annum.

Champaign, Ill.—The new dynamo for the city circuit has arrived, and the all-night light service will shortly be inaugurated.

Monroe, N. C.—A company has been organized, with a capital stock of $25,000, for the purpose of erecting an electric light plant.

Oxford, Ala.—A New Orleans syndicate has proposed to supply Oxford with electric lights, ice factory and water-works, for $10,000.

Portland, Ore.—Quite a number of additional electric lights are being erected, and another main wire has been strung through the city.

Summerville, S. C.—A company is forming, with F. W. Wagener as promoter, for the purpose of erecting an electric light plant.

Greenwood, S. C.—An electric light plant will be put in the Greenwood oil mill, and the same plant will be extended for the purpose of lighting the city.

Key West, Fla.—New machinery and other improvements are being added to the electric light plant by the Key West Gas and Electric Light Company.

Blandinsville, Vt.—Ehite & Risser have been granted a franchise to install an electric lighting plant here, and will require electrical equipment and supplies.

Montgomery, Ala.—At the electric light station a Thomson-Houston plant has been put in, and other improvements made, by the Montgomery Light Company.

Rochester, N. Y.—The Rochester Edison Electric Illuminating Company has decided to extend its plant into the eastern portion of the city. The distributing plant will be on Dyrer alley.

Berkeley, Cal.—The electric lights are all ready. Many private houses have adopted the incandescent lights, some getting electricity from the new company and some from the electric road.

Scranton, Pa.—The Suburban Electric Light Company has run a wire down Lackawanna avenue, is stringing wires into Green Ridge and Providence, and intends to reach every part of that city.

Salt Lake City, Utah.—The Electric Light Company is preparing to set up two 110 h. p. "Ideal" engines and a 150 h. p. engine. These engines will run dynamos capable of furnishing 2,600 incandescent lamps.

Oxford, N. Y.—The board of trustees has awarded the contract for electric lights to F. L. Gamage, in partnership with a Delhi capitalist. Twenty Ball arc lights of 1,200 c. p. each will be used for the streets.

Olyphant, Pa., must go without municipal electric lights. The preliminary injunction granted some time ago to restrain the borough officials from erecting an electric light plant has been made permanent by the court.

Woodstock, Ont.—A new dynamo, weighing 5,000 pounds, arrived by express on Monday of last week for the electric light works. It came from Fort Wayne, Ind. The damaged machinery will be sent back for repairs.

Latrobe, Pa.—A proposition has been accepted from the local company for 28 arc street lamps of 2,000 c. p., at $75 per annum each for the first 25 lights, and $70 for all over that number. The lights are to be supplied by Nov. 1.

Youngstown, O.—The electric light committee have decided to put in a 50-h. p. engine instead of a 36-h. p. engine, so that the number of their lights can be increased at any time if desired. Bids will be considered on 1,200, 1,500 and 2,000 c. p.

Gettysburg, Pa.—The Waynesboro Electric Light Company has awarded the contract for the erection of the building to the American Manufacturing Company, and the steam outfit to the Frick company. The building must be completed by Nov. 15.

Kansas City, Mo.—The Board of Public Works in Kansas City, Mo., has accepted the proposition of the Kansas City Electric Light Company to furnish 128 electric arc lamps of 2,000 c. p. at $119.50 each, the lamps to be lighted every night and all night.

Ebensburgh, Pa.—The Ebensburgh Electric Light and Power Company, of which E. B. Crosswell is president and manager, will erect an electric light plant here at an estimated cost of $8,000, payments to be made in cash. The company wants estimates for an arc system, motors, electric belting, pure copper wire and lamps.

Marching by Electric Light.—Russian troops are practicing forced night marches and other night maneuvers across the river Pruth on the Roumanian frontier with the aid of electric lights. The Roumanian government has become alarmed at these warlike demonstrations, and is consequently concentrating troops on its frontier.

Cambridge, N. Y.—The Cambridge Electric Light and Power Company, W. L. Hitchcock, president, will construct an electric light plant here at an estimated cost of $10,000. All payments to be in cash. A consulting engineer is wanted. The company asks prices on an incandescent electric light system, a 100-h. p. engine, a 120-h. p. boiler, and lamps of 25 c. p.

San Francisco, Cal.—At a recent meeting of the Street Light Committee of the Board of Supervisors it was agreed to recommend that eight of the 4,000-c. p. electric lights now in use in outside districts should be removed, and 64 lights of lesser power substituted, whereby a much larger area may be illuminated with practically no increase in the cost of maintenance.

Frackville, Pa.—The contract for the erection of the Frackville and Gilberton Light and Power Company's plant has been awarded to H. M. McGovern, of Girardville. Work will be pushed at once on the building, which will be 70 × 40 feet in size. The foundations for the boilers are ready, and it is expected that by Nov. 1 electric lights will be burning in both towns.

The Edison General Electric Company has closed a contract for an incandescent plant for the John Campbell flour mills, St. Thomas. The Edison company, in the last few days, has closed contracts in Canada for incandescent plants for the towns of Linsay, Carberry, two large isolated plants for Montreal, and a 300-light plant for the Forbes Milling Company, Hespeler.

The H. C. Frick Coke Company, of Pittsburgh, is introducing electric lights into its mining shafts as rapidly as possible. A few days since, work was completed upon an electric lighting system in one of the shafts of the company located near Mt. Pleasant, Pa., the Westinghouse company furnishing the apparatus. The Frick company express themselves as much pleased with the new method of lighting.

Johnstown, Pa.—The mayor of Johnstown has signed the contract with the electric light company to furnish 146 arc street lights for five years at $108 per year each. In justice to Mayor Rose, says the *Tribune*, in connection with this matter, it ought to be stated that by his course concerning the electric light ordinance he has saved the city $2,628 per annum, or $128 more than his salary amounts to annually.

Normal, Ill.—Among the improvements at the Soldier Orphans' Home has been the putting in of an electric light plant for the illumination of the grounds and buildings. The buildings are all wired, and it only remains to get the power in place and attach the burners, when the illumination will be complete. The power will be furnished by two dynamos of 200 c. p. each. These dynamos are now on the ground and only awaiting the finishing of the dynamo room.

Rutland, Vt.—The Rutland Electric Light Company has given notice to its customers that there will be a change in the price of commercial arc lights Oct. 1. The rates will be by the month instead of by the night, and the change makes a rise of five cents a night, being 15 instead of 10 cents each. The change affects only the commercial lights which burn until midnight and does not change the price of the all-night commercial lights or the incandescent lights.

Charleston, W. Va.—The Citizens' Electric Company, with a capital stock of $20,000, expects to have its electric plant in operation inside of 90 days. The company is receiving bids from various manufacturers. The officers of the company are: Col. B. D. Gibson, president; Gustav Brown, vice-president, and William Campbell, secretary and treasurer. The electrical and mechanical details of the plant are under the direction of Mr. Chas. C. Caldwell, the electrician of the company.

Manchester, N. H.—The committee on lighting streets met last week and opened the bids sent in for lighting the streets of Manchester. There were but two, the Electric company, with its station at Kelley's Falls, and the Manchester Electric Light Company, being the only bidders. The former offered to do business for 39 cents per night for lights on mast arms and 36 for those on poles. The company now holding the contract, which expires at Christmas time, offered to do the same work for 37½ and 34½ cents per night, respectively. The latter company will get the contract, and the saving to the city by it will be over $5,000 per year, or some $13.73 per night.

Mr. D. W. Higgins, president of the National Electric Tramway and Lighting Company, of Victoria, B. C., referring to the descriptive article of his company's station in THE ELECTRICAL WORLD, of Sept. 12, desires us to correct the statement that their arrangement between the company and Mr. Osgood, the Seattle agent for the Thomson-Houston company, was in any way due to "financial difficulties." He states that the company is not now, nor has it ever been, in financial difficulties: that "the arrangement with Mr. Osgood was upon a purely business basis, which the directors believe to be mutually sound and advantageous; the company reserving the right to take the plant and business at the end of two years upon paying cost with five per cent. per annum added, Mr. Osgood meanwhile paying a sum that yields a handsome profit to the company for power supplied."

Allegheny City, Pa.—The sub-committee of the Allegheny sub-Lighting Committee held a meeting last week, at which it was decided not to return to gas lighting. A proposition from the Allegheny Gas Company was received in which it proposed to furnish the gas for 3,000 lamps for $48,000 a year, the city to provide the lamps and erect them. The company also proposed to light and extinguish them and keep them in repair. Each additional lamp would cost $16. Another proposition had been sent to the committee on public safety by the Fort Wayne Electric Company. The company offered a 60-light 2,000 c. p. arc machine with 60 lamps for trial 90 days or four months. It stipulated that the city shall pay the freight on it, set it up in the city plant, hang the lamps and operate it. After testing it the time named, Councils to elect to purchase the machine at a cost not to exceed $5,000, or return it, and no charge would be made for its use. The committee decided to ask for propositions of a like nature from the Thomson-Houston company and the Brush company.

THE ELECTRIC RAILWAY.

An Electric Railway between Lynn and Wakefield is being promoted.

Taunton, Mass., is negotiating for the construction of an electric street railway.

Sumter, S. C.—An electrical railway will be built here, work to commence shortly.

Fall River.—A movement is on foot to build an electric line connecting Fall River, Taunton and Somerset.

Jacksonville, Fla.—An electrical railroad will built by the Jacksonville & Panama Rapid Transit Company.

Rock Hill, S. C.—The dummy line will be changed to the electric system by the Rock Hill Land and Town Site Company.

Baltimore, Md.—The Baltimore Union Passenger Railway Company has applied for authority to extend its lines, and operate by electricity.

Birmingham, Ala.—An electric car line is now about to be introduced, and the promoters promise to have the road in operation the 1st of October.

Wilmington, N. C.—It is reported that a syndicate of capitalists is negotiating for the purchase of the Wilmington Street Railway with a view of running it by electricity.

Worcester.—The Consolidated Street Railway Company have asked for the privilege of equipping their lines for electricity, and the prospects are they will get the permission.

Olean, N. Y.—The Olean street car company has decided to change from horse power to electricity. Application for permission to do so has been made to the board of village trustees.

Thompsonville, Conn., has petitioned the Springfield street railway for a line to that village, and the latter company has promised to build it under certain conditions and have it running by Jan. 1.

From Chicago to Milwaukee.—It is reported that Chicago and Milwaukee are to be connected by an elevated electric railway, the trains on which will run over a mile a minute. The projectors hope to have the road in running order by Jan. 1, 1893.

Reading, Pa.—The Reading & Southwestern electric railroad has been very successful and has already established quite a trade. A member of the company said to a *Telegram* reporter that between 1,500 and 2,000 passengers have been carried daily since the road was opened.

Houston, Tex., has five lines of electric railway, aggregating 15 miles, and operated with 21 motor cars run by electricity furnished by a power house valued at about $30,000. The streets are lighted by electricity. The Citizens' Electric Light Company furnishes 320 arc and 3,000 incandescent lights.

Atlanta, Ga.—The electric line of the Atlanta and Chattahoochee company to the Chattahoochee River has been graded for over half the distance, and in a few months electric cars will be running to Walton at its Forsyth street junction. The capitalists who have this enterprise in hand have thus far met with the co-operation of the property owners along the line.

Defiance, O.—An ordinance has been passed by the City Council granting a franchise for 25 years to the Defiance Light and Power Company to build a street car line. The company proposes to commence work within 60 days and complete 1¼ miles by July 1, 1892, the company to furnish a bond of $10,000 to protect the city from any liability.

A Successful Road.—The new Worcester, Leicester & Spencer Electric Railway is earning on an average $65 per car per day. This road is about 12 miles long, and after deducting operating expenses, wear and tear, etc., there ought to be a hundred per cent. dividend for its owners if the present traffic holds. There are a number of horse railroads in Connecticut anxiously awaiting the reassembling of its Legislature to secure electric franchises.

The City of Bremen will probably soon enjoy the distinction of being the first German city in which horses will have been wholly supplanted by electric power for street car service. A portion of the Bremen street car system has been worked electrically for some time, having been equipped by the Thomson-Houston company. At present, however, arrangements are being made with this company to fit up the whole Bremen system on this system.

A New Electrical Railway.—Parties interested in a new electrical railway from Taunton, to Fall River, running through Dighton, North Dighton, Weir, Somerset and Pottersville, have been looking the ground over, and are reported as being favorably impressed with the project. The rails would run along the shore road, and trains would be run often enough to satisfy all demands for freight or passenger accommodations. The movers are Boston, Taunton and Fall River capitalists.

Another Electric Road.—The West Haven & Savin Rock Horse Railroad, running from what is known as the "Green," New Haven, to Savin Rock, on the Sound, some five miles, has been purchased through Waller, Cook & Wagner, by a syndicate, amongst whom are W. B. Ferguson and E. P. Shaw. As the net earnings of the road during the last year were over $40,000, it is believed that when equipped electrically, and cars run oftener, it will be a veritable bonanza for its present owners.

Boston, Mass.—The citizens of Boston will shortly see a handsome vestibuled electric car running on the West End tracks. It will be a part of the equipment of the Thomson-Houston Company's offices, being a special car for exhibition purposes. It differs from an ordinary electric car in many respects, one being that it has no platforms. At the side, on the rear end, is a door leading into a vestibule. This opens into the main car, which is luxuriously furnished with velvet carpet, damask curtains and handsomely cushioned rattan chairs. The running gear of the car is to be two of the latest patent "W. P." motors of the single reduction gear variety, inclosed in a cast-iron waterproof casing, as the initials indicate. It is now being fitted up at the Lynn works.

GENERAL APPLICATIONS OF POWER.

The Electric Motor in a Printing Office.—The *New Era*, of Lancaster, Pa., of which Mr. J. M. W. Geist is the editor, has what is probably the largest printing establishment operated entirely by electric motors in Pennsylvania. One 20 h. p. Perret motor is used in the main press room to drive a Goss perfecting press, an Adams press, a No. 8 Scott two revolution press, a Flister "Pony" two revolution press and the stereotype machine of the perfecting press. In the job department a 10 h. p. Perret motor operates six job presses, a 36-inch paper cutter, a bronze machine and the stereotype finishing machines. The Perret motor was selected because it develops its full power at a slow speed, dispensing with counter-shafting. Carbon brushes have been in use for eight months, and are giving excellent satisfaction.

MISCELLANEOUS NOTES.

Kearney, Neb.—The new 800-h. p. turbine wheel on the electric power house proved to run perfectly on the first trial. All the shaftings are not set, so the power will not be applied just yet.

Both Mr. Flower and Mr. Fassett are in favor of repealing the unconstitutional clause of the Electrical Execution law prohibiting the publication of the details of executions, and are, therefore, equally entitled to support on that issue.

The New Transformer, made by the Thomson-Houston company for the Okonite Wire Company, of Passaic, N. J., has been tested and gives 23,000 volts electromotive force. It will be used for testing the okonite insulation on pure copper wire.

Driving Belts.—The two largest driving belts ever made in the United States are now being manufactured in St. Louis for an electric power station. They are of three thicknesses of leather, each 72 inches wide and 150 feet long. They weigh about 1,800 pounds each, and each belt contains about 200 tanned hides.

A Good Word for the Trolley.—Some interesting facts were recently brought out in the hearings on the application made by the Coney Island and Brooklyn Railroad to run trolley wires in Brooklyn streets. Several insurance men were put on the stand and their testimony was of considerable interest. Mr. V. R. Schenck, of the American Casualty Insurance Company, said that that organization insured against all kinds of railroad accidents, and believed the trolley system to be a safe method of transit. So far as he could judge from their experience the heaviest losses come from the use of horses, the next from cables, while the trolley system was last on the list. Mr. J. P. Sheldon, president of the Phœnix Insurance Company, said that in their experience the trolley system had produced no extra losses, and it had not been necessary to make any changes in its insurance rates. These facts from men who by reason of their business connections must necessarily take a conservative position are well worth the consideration of those who are inclined to look askance at overhead electric traction.

PERSONALS.

Mr. H. A. Sawyer, the former superintendent of the Electric Light Company, of Amesbury, Mass., will engage in the electrical supply business in Amesbury.

Mr. Samuel Insull, second vice-president of the Edison General Electric Company, New York, and Mr. Eugene H. Lewis, solicitor to the company, have arrived at Winnipeg on their way to the Pacific Coast.

Mr. L. S. Robinson, for a considerable time vice-president and manager of the Electrical Storage and Supply Company, of San Francisco, Cal., has sold out his interest in that business and severed all connection with that company.

Mr. F. W. Baugher, of Indianapolis, long and favorably known in the leather belting trade, is now representing I. B. Williams & Sons, of Dover, N. H., the big manufacturers of oak tanned leather belting, and has already secured some handsome orders from electric central station managers in the West.

Mr. Frederick W. Darlington, of the Westinghouse Electric and Manufacturing Company, who has spent the last year and a half in China engaged in the superintendence of the construction of several electric lighting plants using the Westinghouse alternating current incandescent system, has just arrived home. Mr. Darlington did not find the climate of China distasteful and he says the Celestials are fairly appreciative of the advantages of the electric system of illumination.

Mr. O. T. Crosby, of the Thomson-Houston Company, recently delivered a very interesting address on the electric railway from a sociological point of view before the Thomson Scientific Club of Lynn, Mass. Few people realize thoroughly the great indirect effect of quickened transit on the industries of any region as well as the lives of its working population, and it is quite refreshing to have a special discussion of this phase of the subject as contra distinguished from somewhat threadbare eulogies of the glories of electric traction in general.

The Hon. Wm. L. Scott, vice-president of the Eureka Tempered Copper Company, of Northeast, Pa., and one of the largest stockholders and most prominent directors of the company, died at Newport, R. I., on Sept. 19. The cause of his death was heart failure. It was due to Mr. Scott's encouragement that this company was organized, as he was a director in over 22,000 miles of railroad, and realized the benefit to be derived from the introduction of tempered copper. Mr. Scott was well known in both business and political circles. He was a member of Congress for two terms, and was a warm personal friend of ex-President Cleveland.

LEGAL NOTES.

The Supreme Court of Mississippi has rendered this decision regarding the delivery of telegraph messages: "In order to sustain an action for damages from failure to deliver a telegram, it must be shown that a contract, actual or implied, existed between the sender of the message and the company. When a man writes a message on a leaf of his note book, tears the leaf out and sends it by a messenger to the telegraph office, without paying, or offering to pay, or agreeing to become responsible for the charges for sending it, no contract exists between the parties, and no recovery can be had against the company for failure to deliver."

Important Patent Decision.—Commissioner Simonds, of the Patent Office, has, in a decision involving an invention in electric railways, reversed the decision of Ex-Assistant Commissioner Fisher, thereby awarding priority of invention to the patentee of letters patent No. 305,194, issued Sept. 16, 1884. The decision lays down the general rule governing the question of priority of invention to be that he who is the first to conceive of an invention is entitled to a patent if he reduces it to practice with reasonable diligence, but if he does not reduce it to practice with reasonable diligence, he who is subsequent to conceive, but first to reduce, will prevail. The commissioner further holds that when one of the contestants has a patent and the other is an applicant for a patent for the same invention, the latter, in order to prevail over the patentee, must present a case both as to conception and diligence which does not admit of a reasonable doubt.

Industrial and Trade Notes.

The Whitney Electrical Instrument Company of Boston will soon begin the erection of a large three story factory on the Contocook river in Penacook, N. H., in which 100 hands will be employed.

The Porter Leavitt Motor Company, of Providence, is turning out some excellent work in its small motors for running fans or small machinery, and is making arrangements to increase its facilities to enable the company to fill its orders promptly.

Mr. C. D. Otis, of the Chicago Heights Land Association, Chicago, has secured the location of two more manufacturing companies at Chicago Heights. Electrical manufacturing companies contemplating a change of location should correspond with Mr. Otis.

The Reading & Southwestern Electric Street Railway Company, of Reading, Pa., say that they have two of Wood's patent water tube boilers of 150 h. p. each, and that they are unsurpassed as steam generators, for economy of fuel they have no equal, and have never cost a cent for repairs.

The Whitney Electrical Instrument Company will at once erect a factory, three stories, 50 × 100, at Penacook, N. H., for manufacturing the electrical inventions of E. R. Whitney and Dr. A. H. Hoyt. The company starts off with very bright prospects, and is assured of a good business from the start.

The Electrical Construction Company, Franklin street, Chicago, has received many compliments for the excellent work done on the Phillipson model of the World's Fair that is now being exhibited in Chicago. This model covers 3,000 square feet and has electric lights and electric fountains in operation.

The Chas. Munson Belting Company, of Chicago, writes us stating that certain rumors which have been set afloat regarding the company going out of business are utterly false and untrue, and that the company will continue to exist and manufacture the same high grade belt, for which they have earned such a well-merited reputation in the past.

A Good Boiler Record.—Two of Wood's patent water tube boilers, of 150 h. p. each, in the station of the Cheltenham Electric Light and Power Company, Oak Lane, Philadelphia, have, it is said, been running constantly for two years without requiring to be stopped for repairs. It is stated that they use less than 1¼ tons of pea coal per night.

The Eastern Electric Supply Company will open a branch office in the Rookery, Chicago, shortly. Mr. W. J. Pilicy is to have charge of the office and will travel through the Western States for the company. This move will be appreciated by the company's numerous customers in the West and will undoubtedly prove a good thing for all concerned.

The Ries Electric Specialty Company, of Baltimore, Md., reports being very busy supplying the demand for its new regulating socket for alternating current incandescent lamps. This company is about completing an additional large plant, to what it already has in operation, and in a few weeks will be ready to turn out these goods at the rate of 1,500 per day.

Lynn, Mass.—In case of the success of the generator and equipments recently sent from the Lynn factories to Bahia, Brazil, for the 1½ mile narrow gauge track, an order for 65 more cars will follow it. The order for this sample plant was placed July 23, and the apparatus was ready for shipment on the steamship Segurenca Aug. 12. It will be the first electric road in that country.

A Swinging Lamp Bracket.—Mr. F. H. Soden, of Bliss & Soden, Chicago, is placing on the market a new lamp bracket that may find ready sale wherever a swinging bracket for incandescent lighting is desired. The arm has a right and left movement and is manufactured in double or single form. It can be made rigid by simply tightening two screws placed on the side of the joint.

The Goulds Manufacturing Company, of Seneca Falls, N. Y., reports an increasing demand for the electrically operated parts of its pumping machinery as well as of other apparatus. The catalogue recently issued by the company has apparently already attracted the attention of buyers, and there is every reason to anticipate an increasing use of this most valuable and convenient class of machinery.

The D. M. Steward Manufacturing Company, of Chattanooga, Tenn., which has placed on the market so many of the Steward lava insulators for electrical purposes, reports business very brisk. Orders for lava insulators and the number of users of these goods are constantly increasing. The company is now turning out from 50,000 to 100,000 insulators every week. The circular which the company issues contains full descriptions of these goods and a few testimonials from their users.

The Woonsocket Rubber Company, through its general salesmen, reports that jobbers are being pushed hard to supply their trade. "There is a first class demand for heavy goods," said one of the firm, and no complaint can be made on the general tone of the market. The corner on crude rubber has not affected the price of goods, and the present quotations are based on figures very nearly similar to the market of last January."

Gales' Commutator Compound is highly indorsed by electric light men, who report that "it prevents sparking;" "keeps the surface smooth and entirely eliminates sparking of the brushes." "It not only prevents sparking but keeps the commutators in good condition and prevents cutting." "It saves labor in keeping the machines in good order and lessens repairs on the commutator." "I have used it for two years and am more than pleased with it."

The Tropical American Telephone Company, says General Manager Howard, is turning its ready capital about three times a year at a fair profit, and is enlarging its field and extending its business month by month. It has control of several important patents which it can use in its export business, and in 1893 can employ the devices to good purpose in the United States. The sales for August were over $14,000, and sales in 1890 were 50 per cent. greater than sales in 1889.

The Premier Camera.—One of the well known electrical constructing engineers in the West recently said that an extended experience with several forms of portable cameras had convinced him that for the traveling electrical engineer, the 5 × 7 Premier was the best camera on the market, and in support of his opinion showed some recent central station views he had secured that were marvels of photographic art. The Rochester Optical Company, Rochester, N. Y., will mail a descriptive circular containing much of interest to any one applying for same.

Bristol, R. I.—The National India Rubber Company has now worked up an extensive business in the manufacture of electric wire, so that its Narragansett rubber wire is becoming widely known. The wire, of the purest lake copper attainable, is first given a covering of fine Para rubber, which is semi-plastic in form, making a seamless coating; it is then wound with rubber tape, and covered with a continuous waterproof envelope. The whole insulation is then vulcanized, leaving the wire with a smooth and uniform finish. A considerable amount of this wire is in use in the New York subways.

The Bradbury-Stone Storage Battery Company, of Lowell, has scored a great success in street railway work, as was successfully and practically demonstrated a few days ago on the streets of Sioux City, Iowa. A party of people interested in street railways throughout the West were treated to a twenty-mile ride on a car fitted with this company's battery, which was made without a hitch of any kind. The climbing of a steep hill with a continuous curve over a mile in length was one of the severe tests to which the car was put, and which was done to the complete satisfaction of all in the party.

The Rollason Gas Engine is fully described in a pamphlet just issued by the Electric Manufacturing and Gas Engine Company, of Greenbush, N. Y., which company is the sole maker of this engine in the United States. A description and illustration of it were published recently in the columns of The Electrical World. The pamphlet contains additional illustrations and descriptions of the various types of the Rollason engine, together with abstracts from the various journals in which it has been described. The general office of the company is at 134 Liberty street, New York City, and Mr. H. W. Harris is general sales agent.

Messrs. J. W. Queen & Co., of Philadelphia, the well known dealers in electrical testing apparatus and the like, have just issued a very complete new catalogue of electrical testing apparatus and accessories that is by all odds the most complete of its kind that has yet appeared in this country. Particularly to be noticed are some of the specialties to which Queen & Co. are just now giving considerable attention; one of them is a hot wire voltmeter, similar to the Cardew pattern; a very complete electric light photometer; two sizes of Brackett's cradle dynamometer for dynamo and motor testing, and several elaborate and complete forms of galvanometers for general use.

The Wightman Electric Manufacturing Company, of Scranton, Pa., has already placed its motors in operation on a number of electric railways in various parts of the country, and has received from the managers of these roads some excellent testimonials as to their merits. Among these may be mentioned that of the Auburn Street Railway Company, at Auburn, N. Y., whose superintendent says the motor makes "no noise whatever"; the Peoples' Street Railway Company, at Scranton, Pa., whose master mechanic reports that the "cars are very fast, make no noise and give no trouble"; and the Pennsylvania Motor Company, whose secretary and treasurer reports that the "six cars, fully equipped with Wightman apparatus, are giving entire satisfaction; that the motor is a fine piece of machinery, clean, noiseless and economical."

The Page Belting Company, of Concord, N. H., has recently filled orders for the various sorts of belting as follows: A complete outfit for the Derry (N. H). Electric Light Company; a 26-inch belt for the Southwestern Electric Light and Water Power Company, of Joplin, Mo.; three 48-inch belts for the Georgia Electric Light Company, at Atlanta, Ga. The company has also furnished of its new Eureka dynamo slotted belts as follows: One 12-inch belt for the Concord Street Railway; four 14-inch belts for the Schuylkill Electric Railway Company, at Pottsville, Pa.; one 10-inch belt for the Amsterdam Street Railway Company, Amsterdam, N. Y. Of regular dynamo belting the company has furnished as follows: One 12-inch belt for the Hyde Park Electric Company, Hyde Park, Mass., and three 13 and one 10 inch belt for the Birmingham Railway and Electric Company, Birmingham, Ala.

Business Notices.

Battery Cut-Out, Cheap.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Co., of 105 South Warren street, Syracuse, N. Y.

Mr. W. S. Chesley, of 136 Liberty street, this city, has sold a 45-light 1,200 c. p. Thomson-Houston dynamo and two No. 10 Edison dynamos. Mr. Chesley is handling job lots of sockets and has recently sold 2,500 New Edison key sockets.

The Wolverton Glow-Arc Electric Light Company, at its recent meeting at its office, 1,671 Third avenue, New York, discussed the question of making arrangements to secure the American and European patents of Prof. J. E. Woolverton on several improvements in electric lighting. The company expects soon to establish a plant in this city.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

U. S. PATENTS ISSUED SEPT. 29, 1891.

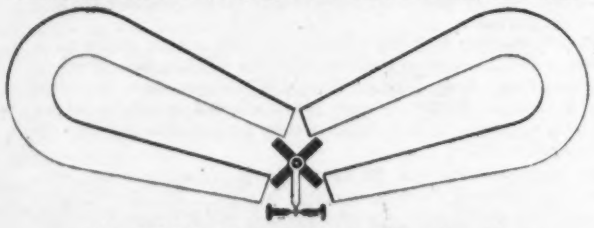
460,109. Telegraphic Transmitting Instrument; Charles G. Burke, of Richmond Hill, N. Y. Application filed June 17, 1890. A cable transmitter having a key and an automatically actuated contact-maker locked and released by the said key and provided with contact surfaces adjustable relatively to one another, whereby the duration of contact for a given movement may be limited.

460,110. Telegraphic Instrument; Charles G. Burke, of Richmond Hill, N. Y. Application filed Dec. 26, 1889. A telegraphic instrument consisting of two coils mounted or supported on a vertical axis at substantially right angles and movable within a field of force created by four magnetic poles of which those in proximity to the opposite sides of same coil are of unlike polarity. (See illustration.)

460,111. Telegraphic Instrument; Charles G. Burke, of Richmond Hill, N. Y. Application filed Feb. 11, 1891. The combination, with two coils mounted or supported by independent terminal supports, independent magnetic fields in which said coils are mounted and free to turn, the coils being connected with a signaling or capable circuit and adapted to turn in the magnetic fields in the same direction, of a recording or signaling mechanism and flexible connections between the movable parts thereof and each of the coils, whereby both the latter co-operate in the operation of the same.

460,122. Process of and Apparatus for Generating Electricity; Thomas A. Edison, of Menlo Park, N. J. Application filed May 26, 1882. The process of generating electricity, consisting in subjecting a body of carbon or carbonaceous material to a high temperature in the presence of an active agent composed of a body of oxides capable of combining with carbon at a high temperature, and a positive element composed of a metal not acted upon by such active agent, but located in contact therewith.

460,125. Dynamo or Electric Motor; William M. Fink, of Elizabeth, N. J. Application filed Oct. 7, 1890. A dynamo or electric motor consisting of the combination of a ring armature, arc-shaped pole pieces enveloping three sides, including the interior



No. 460,110.—Telegraphic Instrument.

side of the ring armature, a rectilinear field magnet joining the two pole pieces, and a shaft for the armature, located and terminating upon one side of said field magnet.

460,140. Electric Safety Catch; John W. Howell, of Newark, N. J. Application filed Jan. 6, 1891. A safety catch for electric circuits, composed of a conductor of electricity, which is destroyed by chemical action (as distinguished from fusion) when an abnormally large current passes through it.

460,163. Trolley for Electric Railways; Frederic F. Smith, of Woburn, Mass. Application filed Dec. 20, 1890. A trolley for an electric car, consisting of a supporting spindle, a pair of independent discs which freely move thereon, and one or more springs which constantly tend to press said discs towards one another.

460,199. Circuit Controlling Apparatus; John P. Cushing and William J. Kelly, of Boston, Mass. Application filed Nov. 6, 1890. In a circuit controlling apparatus or switchboard, a supporting frame and a plurality of resistance heads secured thereto, and provided with a plurality of contact members or terminals to which the resistances are connected, combined with a plurality of independently movable contact arms co-operating with the said contact terminals or members, an actuating device for said contact arms, handles connected to said contact arms to move therewith, and means to detachably connect the said contact arms with the actuating device.

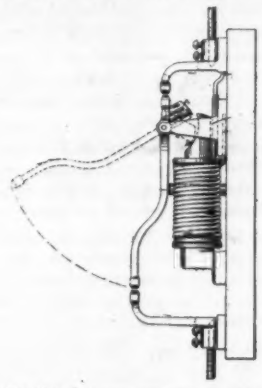
460,235. Electrode for Secondary Batteries; John B. McDonald, of Chicago, Ill. Application filed Feb. 5, 1891. In a storage battery a grid for the support of the active material, composed of a metal ribbon having indentations or raised portions upon its surface and bent back and forth upon itself to form the supporting frame.

460,245. Switch for Series Dynamo Electric Machines; Craig Ritchie Arnold, of Sharon Hill, Pa. Application filed Nov. 10, 1890. The combination with a series wound dynamo electric machine of a circuit making and breaking switch for throwing the machine out of action and disconnecting it from the line, having a contact through which the series circuit of the armature field and translating devices is completed in series, said contact being connected directly to one terminal of the field magnet coil and placed in position to be engaged by the switch in passing from position of circuit closed to circuit broken and before it leaves the first mentioned contact.

460,287. Electric Alarm; Charles H. Shaffer, of Rockford, Ill., Assignor to the Electric Alarm Company, of Muskegon, Mich. Application filed June 20, 1890. The invention comprises an alarm circuit, a battery, a telephone line connecting a subscriber's telephone with the central telephone station, a signal box having connections with the alarm circuit and telephone line, a device for forming a communication between the alarm circuit and central telephone station, and means controlled by the box for operating the device when the box is released by a sufficient change in the alarm circuit.

460,289. Lightning Arrester; James J. Wood, of Brooklyn, N. Y. Application filed Sept. 25, 1890. A lightning arrester having three discharge plates with two intervening breaks, one of the terminal plates connected to the dynamo and line and the other to earth, and a shunt circuit connecting one of the terminal plates to the intermediate plate, and an arc rupturing device adapted to act upon the passage of a current through said shunt and to extinguish the arc between the other terminal plate and the intermediate plate. (See illustration.)

460,328. Printing Telegraph; John E. Wright, of New York. Application filed Dec. 30, 1890. In a printing telegraph instrument having a ratchet or escapement wheel and a magnet for setting the same in any desired position, of a rotating type wheel, a cam intermediate to the type wheel and the escapement and a magnet for moving the cam and adjusting the type wheel to positions corresponding to those of the ratchet or escapement wheel.

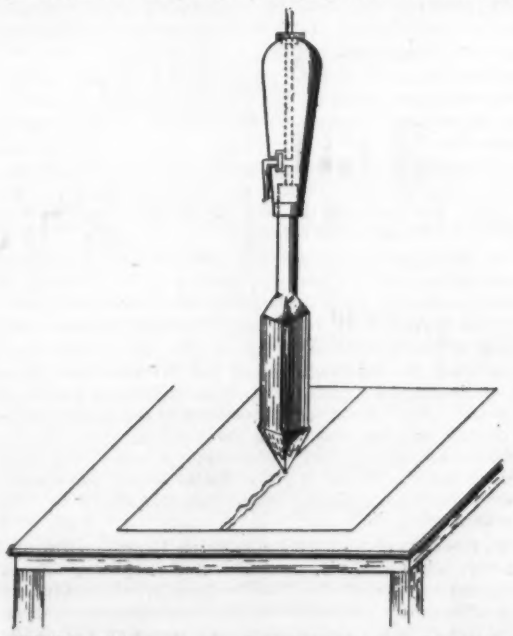


No. 460,289.—Lightning Arrester.

460,349. Printing Telegraphic Apparatus; Gilbert Alfred Cassanes, of Paris, France. Application filed Nov. 28, 1890. The combination, in a receiving printing instrument, of series of printing wheels, on the same shaft or carrier with a corresponding series of toothed snails, and with a corresponding series of superimposed slides, supporting stems and electromagnets all arranged for conjoint action upon one or more of said printing wheels at one time.

460,364. System of Electrical Distribution; Edwin Wilbur Rice, Jr., of Lynn, Mass., Assignor to the Thomson-Houston Electric Company, of Connecticut. Application filed Feb. 13, 1891. The combination of a multiple series distribution system with an equalizing machine connected in shunt around one of the multiple-arc groups and serving as a motor or generator, according as the major load shifts from one side to the other side of the system, said machine being coupled mechanically with the main generator so as to return and receive power from the same source of energy.

460,372. Dynamo; William Henry Elkins, of Cambridge, Mass., Assignor by direct and mesne assignments to the American Electric Machinery Company, of Portland, Me. Application filed Nov. 28, 1890. The method of regulating dynamos by dividing the main current in two portions, carrying both of those portions



No. 460,428.—Method of Soldering or Brazing by Electricity.

through the work circuit and through a coil on one leg of the field magnet, which coil has a materially smaller number of turns than the coil on the other leg of the field magnet and carrying the other portion before it joins the first through the latter coil, which has a materially greater number of turns than the former coil.

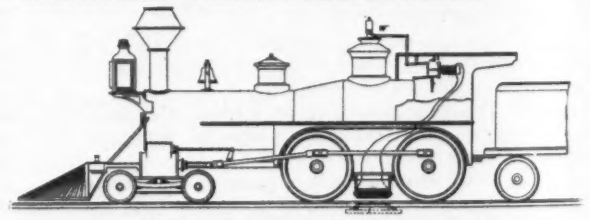
460,416. Push-Button; John E. White, of Syracuse, N. Y. Application filed Aug. 21, 1889. The combination, with a casing and separable cap, of a connecting device, a normally inactive spring adapted when released to separate the cap from the casing, and a cylindrical fusible retainer confined around the connecting device between the cap and the flange on the outer end of the connecting device.

460,428. Method of Soldering or Brazing by Electricity; Charles L. Coffin, of Detroit, Mich. Application filed April 17, 1890. The process of soldering or brazing, consisting in connecting one or both of the articles to be soldered or brazed with one pole of a generator, connecting the tool to the other pole of the generator, bringing the tool in contact with the solder and seam to be soldered or brazed, and passing an electric current through the tool and material while the tool is maintained in contact with the solder and seam. (See illustration.)

460,448. Insulator; Frank Atherton Ross, of Livingston, Mont. Application filed Dec. 16, 1890. An insulator body having a vertical cavity in its top and a vertical slot intersecting the cavity and having a transversely corrugated bottom, and a rotary cap having a screw threaded connection with the said body and having an integral depending projection turning in the said cavity, and having its lower end shaped to the corrugated bottom of the slot to bend the wire.

460,457. Printing Telegraph Instrument; John E. Wright, of New York. Application filed Dec. 31, 1889. In a column printing telegraph instrument, the combination, with a rotary type wheel, a clock motor for turning the same, and an electro-magnetic controlling device, of a swinging paper carrying or impression roll, an electro magnet for moving the same, a clock-motor geared with the paper roll, and an electro-magnet for controlling the movement of the said motor.

460,464. Automatic Electric Fire Alarm System; William S. Cook, Moses Chalmer Cook and Albert H. Morrow, of South Omaha, Neb. Application filed Oct. 13, 1890. A fire alarm system comprising a normally open alarm circuit grounded at both ends, and including a thermostat and starting electromagnetic devices of the call box and extending to the station, a normally closed signal circuit connecting the call box and station relay, and local circuit or circuits controlled by said relay and connected with said alarm circuit and actuating the register or indicator.



No. 460,525.—Electric Railway Signal.

460,488. Trolley Switch; Harry L. Pierce, of Leominster, Mass. Application filed Oct. 22, 1890. A switch for electric conductors, having a main plate and leads extending therefrom, and arranged to be secured to the main conductors, a hinged tongue adapted to be swung into line with the terminals of the leads, a switch lever for operating said tongue, provided with a lug arranged to be operated by the trolley wheel, and a suitable spring for holding the same in normal position.

460,503. Electric Bell; Walter Hay, of Chicago, Ill., Assignor of one-half to George E. Horn, of same place. Application filed May 11, 1891. The free end of the armature is provided with a threaded hole in which an ordinary screw is inserted. The screw may be adjusted with relation to the bell without disturbing the adjustment of the armature.

460,524. Electrical Railway Signaling Apparatus; William F. Z. Desant, of New York. Application filed Sept. 26, 1890. A system of electrical block signals having sets of insulated rails connected together in diagonal pairs, one set being in one block and the other set in an adjacent block, and a visual signal for each block and a two part magnet adapted to control each signal, one portion of said two part magnet being connected to the ends of the rails of one block, and the other to the ends of the rails of the next succeeding block in advance.

460,525. Electric Railway Signal; William F. Z. Desant, of New York. Application filed Sept. 26, 1890. In a railway signal, the combination of the following elements, a series of electrically divided blocks having an electrical generator and a relay for each block, a local circuit for each relay, including an electrical motor geared to a semaphore, a second local circuit for each signal, including an inductorium located near the road bed, and circuit making and breaking devices connected to the semaphore, with an audible signal carried by a moving train and connected in circuit with a second inductorium adapted to be carried in close proximity to the first-named inductorium. (See illustration.)

460,538. Thermal Cut-Out; John Otis Phillips, of New York. Application filed Jan. 6, 1891. A pendant thermal cut out composed of two sections having end caps or pieces consisting of non-conducting material in combination with a band rigidly secured to one of said pieces, a rotary band embracing the rigid band, double pole and double thermal connections located within said sections, and pins operating within interlocking slots.

460,541. Electric Elevator; Rudolph C. Smith, of Yonkers, N. Y., Assignor by mesne assignments to the National Company, of Illinois. Application filed Dec. 31, 1890. The combination, with the cage of an elevator and an electromotor for operating the same, of a switch controlling the circuits through the electric motor, a shunt of high resistance around the switch, another shunt of lower resistance controlled by the high-resistance shunt, and means controlled by the said low-resistance shunt controlling the operation of the motor.

Copies of the specifications and drawings complete of any patent mentioned in this record—or of any other patent issued since 1886—can be had for 25 cents. Give date and number of patent desired and address The W. J. Johnston Co., Ltd., Times Building, N. Y.